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(54) Title: **INDUCTION OF IMMUNE TOLERANCE**

(57) **Abstract:** Methods and compositions for the induction of immune tolerance in mammalian antigen presenting cells such as dendritic cells, macrophages, monocytes and B-lymphocytes are described. Such methods and compositions involve the use of agonists of the cell surface receptors CD36, CD51, thrombospondin receptors and/or the  $\beta$ -integrins which when exposed to an antigen-presenting cell such as a dendritic cell are able to inhibit maturation therein. Thus, the cells' ability to promote an immune response is inhibited. Tolerance to a specific antigen can be induced in antigen-presenting cells by exposure to one or more of the aforesaid agonists and the antigen. Thus, cell preparations can be prepared for administration to humans where tolerance to a specific antigen or antigens needs to be induced, for example in the case of allograft or xenograft transplants or in autoimmune disease.

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**INDUCTION OF IMMUNE TOLERANCE**

The invention relates to the field of immune suppression and, in particular, to the identification of molecules which act as agonists of the cell surface receptors CD36, CD51 and thrombospondin receptors expressed on mammalian dendritic cells and other antigen-presenting cells, to *ex vivo* and *in vivo* uses of such molecules for inducing peripheral immune tolerance in mammals, to identification of molecules which inhibit the state of immune tolerance induced in a human by the binding of red blood cells infected with the malarial parasite to dendritic cells and to *in vivo* uses of such molecules in treating malaria.

Dysfunction of the immune system has been shown to play a role in the initial development and further progression of many human diseases. Impaired immune function can result in inability to fight infection or to destroy malignant cells as they develop within the body. Other diseases are caused because the immune system mounts an inappropriate response to a particular antigen. This inappropriate response might be to an external antigen resulting in atopic disease such as hay fever, asthma, eczema, coeliac disease and the like or to the body's own antigens resulting in auto-immune disease. For example both the non-organ specific auto-immune diseases, such as systemic lupus erythromatosis and rheumatoid arthritis and the organ specific auto-immune diseases such as auto-immune haemolytic anaemia and idiopathic thrombocytopenic purpura are associated with an inappropriate T-cell response to self-antigens.

Other auto-immune diseases where the antigen has been defined include auto-immune connective tissue syndromes, insulin dependent diabetes mellitus and auto-immune thyroid disease. Diseases where the antigen is less well defined include auto-immune skin

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diseases such as eczema, psoriasis, alopecia areata and vitiligo, auto-immune diseases of the gastrointestinal system such as inflammatory bowel disease and auto-immune hepatitis, auto-immune diseases of the nervous system such as multiple sclerosis and myasthenis gravis and auto-immune diseases of the kidney such as glomerulonephritis.

In view of the diseases associated with inappropriate immune response, particularly T-cell response, it is highly desirable to develop pharmaceuticals which are able to damp down certain of the body's immune defence mechanisms in order to alleviate the distressing symptoms associated with these diseases.

As well as treatment of diseases specifically associated with a mal-function of the immune system, down-modulation of immune mechanisms is desirable in circumstances where a recipient is exposed to allo-antigens or xeno-antigens for therapeutic purposes such as recipients of allogeneic or xenogeneic transplants. An allogeneic response in the case of allogeneic bone marrow transplantation or donor lymphocyte infusion might be avoided if one could induce a state of peripheral immune tolerance against donor cells in the recipient. Other examples of situations where down-modulation of immune mechanisms might be desirable include haemolytic disease of the new born, neo-natal allo immune thrombocytopenia or the therapeutic administration of antigenic substances such as blood products e.g. factor VIII, or any other therapeutic or prophylactic agent likely to induce an unwanted cellular immune response.

A cellular immune response is mediated by T-lymphocytes which are activated by antigen presenting cells, the most important of which are dendritic cells, which present antigen and activate memory T-cells and naive T-cells. Dendritic cells become

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potent antigen-presenting cells when exposed to an immune stimulus and thereafter are described as "mature". Maturation confers enhanced ability to stimulate T-cells and a reduction in pinocytosis and phagocytosis compared with immature cells. Furthermore, maturation is accompanied by enhanced cell surface expression of HLA Class I and class II molecules as well as adhesion molecules, including CD54 and co-stimulatory molecules such as CD80, CD86 and the cell-surface marker CD83. Maturation of dendritic cells is also accompanied by the secretion of cytokines such as TNF $\alpha$  and IL12p70. The secreted cytokines have an autokrine effect on dendritic cell maturation itself and parakrine effects on interacting T-cells.

Immature dendritic cells present the cell surface antigens CD36 and CD51 ( $\alpha_v$ ) (part of the vitronectin receptor  $\alpha_v\beta_3$ ). CD36 and integrin heterodimers  $\alpha_v\beta_3$  or  $\alpha_v\beta_5$  can be cross-linked by the soluble bridging molecule thrombospondin (TSP). Through studies of malarial infection the present inventors have discovered that dendritic cell maturation on exposure to an immune stimulus, for example, lipopolysaccharide (LPS), can be inhibited by molecules which bind to CD36 or to CD51 or both via the bridging molecule TSP and which act as agonists thereto.

This discovery is based on the inventors' initial observations that red blood cells infected with the material parasite *Plasmodium falciparum* adhere to dendritic cells via CD36 and/or TSP/CD51 (see Figure 1) and are able to inhibit the maturation thereof on exposure to LPS.

*Plasmodium falciparum* is one of the most successful human pathogens for which virulence factors remain poorly defined, although adhesion of infected erythrocytes to venular endothelium has been associated with some of the symptoms of severe



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disease. Immune responses are unable to prevent symptomatic infections throughout life and immunity to severe disease develops only slowly during childhood. Understanding the obstacles to the development of protective immunity is crucial for rational approaches to prevent the disease.

Specific immunity to malaria has been attributed to cytotoxic lymphocytes active against the liver stage of infection or to antibodies reacting against blood stage antigens. Antigenic diversity, clonal antigenic variation and T-cell antagonism may contribute to evasion of the protective and parasitocidal host responses.

Furthermore, it is known that *Plasmodium falciparum*-infected erythrocytes adhere to endothelial cells and it has been widely assumed that this adhesion has evolved to mediate sequestration of parasites to endothelial cells in the peripheral tissues and so reduce their destruction by splenic macrophages.

The present inventors have now identified a further mechanism by which the malarial parasite prevents the infected host from mounting an effective immune response and preventing recurrence of the disease.

Specifically, the inventors have observed that human erythrocytes which are infected with *Plasmodium falciparum* are capable of adhering to human dendritic cells and that immature dendritic cells exposed to infected erythrocytes are no longer able to mature into full antigen-presenting cells or to stimulate T-cell proliferation, when subsequently exposed to an immune stimulus. However, this state of immune tolerance is not observed when the dendritic cells are exposed to uninfected erythrocytes, uninfected erythrocyte lysate, infected erythrocyte lysate, parasite-conditioned medium or a crude pigment

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preparation derived from infected erythrocytes. Further, the effect is not observed when dendritic cells are exposed to erythrocytes infected with a *Plasmodium falciparum* strain T9/96 which is known not to be able to adhere to endothelial cells (Gardner et al (1996) Proc. Natl. Acad. Sci. USA 93 pp 3503-3508). This particular strain is not able to induce expression on the surface of infected erythrocytes of the parasite-derived protein pf-EMP-1 which is known to undergo clonal antigenic variation and is thought to be the mediator of adherence to endothelial cells. It has been reported that most parasite lines and clones adhere to the known cell-surface receptors CD36 and via TSP to CD51/61 ( $\alpha_v\beta_3$ ). It is also known that pf-EMP-1 can bind to CD36. (see WO 96/33736).

The present inventors have now shown that CD36 and CD51 influence the process of dendritic cell maturation and that agonists thereof, including the malarial parasite derived protein pf-EMP-1, antibodies specific for CD36 and CD51, negatively charged phospholipids and apoptotic cells, are able to inhibit dendritic cell maturation in response to an immune stimulus. These agonists reduce the ability of the dendritic cells to stimulate T-cell proliferation in response to an antigen to a level which is lower than cells which have not been exposed to an immune stimulus at all. Thus, agonists of CD36 and CD51 can induce a state of immune tolerance.

It follows that agonists of CD36 and CD51 would be useful for the treatment of the types of autoimmune disease described above where an over-reaction of the host immune system is responsible for the symptoms. Further the inventors have found that dendritic cells may be treated by CD36 and/or CD51 agonists *in vitro* together with an antigen specific to the immune-response manifested in the auto-immune disease in question. Thus, tolerance may be induced to a

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specific antigen so that, when the dendritic cells are reintroduced into the host, further auto-immune reaction is avoided or substantially reduced. In addition CD36 and CD51 agonists are useful for  
5 inducing a state of immune tolerance in both host and donor dendritic cells where bone marrow transplantation or lymphocyte infusion is contemplated. The feasibility of such treatment is demonstrated herein *in vivo* in mice. The ability to  
10 inhibit maturation of dendritic cells can be demonstrated *in vitro* so that molecules which act as CD36 or CD51 agonists can be easily identified in a high throughput screening assay.

As used herein the term "agonist" means a  
15 composition, molecule, cell or a component thereof which induces the same response when interacting with a receptor as the naturally-occurring ligand for that receptor.

In accordance with a first aspect the invention  
20 provides a method of identifying a molecule which is an agonist of cell surface receptor CD36 and/or CD51 as expressed by mammalian dendritic cells which method comprises:

- 25 a) exposing immature mammalian dendritic cells to the molecule to be tested,
- b) exposing said immature dendritic cells to an immune stimulus and
- 30 c) determining the degree of maturation manifested by said dendritic cells,

wherein impaired maturation in response to the immune  
35 stimulus is an indication that said molecule under test is a CD36 and/or CD51 agonist.

Preferably, the method is performed using human

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dendritic cells. As used herein the term dendritic cells means cells that present antigen to and activate lymphocytes and which are distinguished by their ability to activate, not only memory T-cells but also naive T-cells. Dendritic cells for use in the method of the invention may be derived by cultivation of adherent peripheral blood mononuclear cells with the addition of Granulocyte-Macrophage Stimulating Factor and Interleukin-4 for about 6 to 10 days. Such dendritic cells can be characterised by their level of expression of the cell-surface markers HLA Class I and II (high), CD11 c (high), CD3 and CD19 (negative), CD14 (low) and CD86 (high). These markers distinguish them from B-cells which are positive for CD19, T-cells which are positive for CD3 and macrophages which are CD14 high and CD86 low. (See Banchereau et al, (1998) *Nature* 392, 245-252). Antibodies to HLA Class I, HLA class II, CD14, CD3, CD19 and CD86 useful for identifying immature dendritic cells are commercially available as indicated in Table 1 below.

Dendritic cells which may be used in the method of the invention can also be derived directly from circulating peripheral blood mononuclear cells or by culture of CD34+ stem cells as described by Caux et al (1996) *J. Exp. Med.* 184:695-706 and Arrishi et al (1999) *Blood* 93:2244-2256.

There are various ways in which maturation of dendritic cells in response to an immune stimulus, may be measured. On maturation the dendritic cells become potent antigen presenting cells. As aforesaid maturation is accompanied by enhanced cell surface expression of HLA Class I and II molecules such as HLA DR, adhesion molecules such as CD54 and co-stimulatory molecules such as CD40, CD80, CD86 and CD83 which is a specific marker for mature dendritic cells. Thus, examination of the cell's antigen presenting ability, for example variety of antigens and/or level of

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expression, is one way of determining whether maturation has occurred or whether it has been inhibited by the test molecule. Preferably, following immune stimulation, the level of expression of the HLA Class I and II molecules and/or adhesion molecules and/or co-stimulatory molecules is measured. In one embodiment maturation of dendritic cells is detected by measurement of the level of expression of two or more of the cell-surface antigens HLA DR, CD54, CD40, CD83 and CD86 whose level of expression is particularly enhanced. Preferably, the level of expression of all of the above in response to an immune stimulus is measured. Optionally the expression level of CD80 may also be measured.

Methods by which the expression of a cell-surface antigen may be quantified are well-known to those skilled in the art. The commonly used method is to apply an antibody specific for the antigen in question to the antigen-presenting cells which has been labelled to give a quantifiable detectable signal. Suitable labels are well-known to those skilled in the art and include radioactive labels, enzyme labels, fluorescent labels, metallic particles and the like. Antibodies suitable for carrying out the screening method of the present invention, as well as a commercial source, are shown in Table 1 below:

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TABLE 1

5		<u>Antigen</u>	<u>Antibody</u>	<u>Source</u>
		HLA DR	BF-1	Serotec
		HAL Class 1	W32/6	ATCC HB-95
10		CD14	Tük4	DAKO
		CD54	6.5B5	DAKO
		CD40	LOB7/6	Serotec
		CD80	BB1 or DAL 1	Serotec
		CD83	HB15a	Serotec
15		CD86	BU63	Serotec
		CD3	OKT3	ATCC CRL-8001
		CD19	HD37	DAKO
		CD36	clone 89	Serotec
			clone SMØ	Immunocontakttec
20	<p>Serotec: 22 Bankside, Station Approach, Kidlington, Oxford, UK DAKO Ltd: 16 Manor Courtyard, Hughenden Avenue, High Wycombe, Bucks HP13 5RE</p> <p>Immunokontakt: Centro Nord-Sud, CH-6934 Bioggio, Switzerland, Peprotec: 23 St. James Square, London SW9Y 4JH, UK, ATCC: 10801 University Boulevard, Manassas, VA 20110-2209; USA, Sigma: Sigma Alderich Company Ltd: Fancy Road, Poole, Dorset, BH12 4QH, UK, Schering-Plough: Schering-plough House, Shire Park, Welwyn Garden City, Herts, AL7 1TW.</p>			
25				
30				
35	<p>As an alternative to measuring the level of cell surface antigen to determine whether or not dendritic cell maturation has occurred, it is possible to measure the cell's ability to induce T-cell proliferation. This is inhibited by agonists of CD36 or CD51. Dendritic cells which have been exposed to the molecule to be tested and to an immune stimulus</p>			

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may be exposed to T-cells, for example allogeneic lymphocytes in a mixed lymphocyte reaction (MLR) with the T-cell receptor. The T-cells respond by growing and dividing, something which can easily be measured using methods well-known to one skilled in the art. For example, growth and division can be assessed visually using a light microscope to observe clumps of dividing cells. Alternatively, cell proliferation can be quantified using a suitably labelled metabolite, for example tritiated thymidine, which is incorporated into the cell's DNA.

A yet further alternative for determining the degree of dendritic cell maturation is to measure the level of secretion of cytokines such as  $\text{TNF}\alpha$ , IL2p70 or IL10.

For example IL12p70 is secreted by mature cells but not by immature cells. The level of  $\text{TNF}\alpha$  secretion is reduced in immature as opposed to mature cells. Kits are commercially available for detection and quantitation of all of the above cytokines. (see Examples). Preferably, the levels of  $\text{TNF}\alpha$ , IL12p70 and IL10 secretion are measured.

In the screening method of the invention a variety of immune stimuli may be used. Suitable examples are lipopolysaccharide (available from Sigma),  $\text{TNF}\alpha$  (available from Peprotec) and monocyte conditioned medium (MCM) the preparation of which is described by Romani et al (1996) J. Immunol. Methods, Sep 27; 196(2):137-51. Another suitable immune stimulant is CD40L which is expressed from plasmids having the ATCC Accession No's 79812, 79813, 79814 or 79815. The plasmids may be expressed in mouse fibroblasts STO (ATCC-CRL-1503).

It will be understood that  $\text{TNF}\alpha$  would not be used as both immune stimulant and indicator of cell maturation in the same assay.

In a particular embodiment of the method of the

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invention immature dendritic cells (about  $10^6$ ) are exposed in duplicate to various concentrations of the test molecule for about 3 to about 12 hours in a multiwell plate. The test compound is prepared in a suitable diluent which is not toxic to the dendritic cells such as tissue culture medium, PBS, water or a suitable non-toxic organic solvent, if appropriate. The duplicate wells are subsequently exposed to LPS (about 500 ng/ml) or left untreated for about 48 hours. For each concentration of the compound and time of exposure, the surface expression of the molecules identified above is compared with the surface expression on immature dendritic cells exposed to the test compound as well as untreated immature dendritic cells. The increase in cell surface expression is evaluated using indirect immunofluorescence and FACScan analysis. A compound is a candidate for further evaluation if the surface expression on dendritic cells of at least two cell-surface antigens is not increased by addition of the immune stimulant, LPS.

Preferably, molecules identified as potential CD36 or CD51 agonists by the method of the invention will be subject to further evaluation. For example, if surface expression of lineage-specific molecules has been used to determine the degree of maturation it would be usual to check whether the compound can also prevent immune-stimulated dendritic cells from inducing proliferation of T-cells and visa versa. The ability of the molecule to vary cytokine secretion could also be tested. In addition direct binding of the candidate molecule to CD36, CD51 or TPS should also be confirmed. This latter confirmation may be easily obtained by applying a sample of the candidate molecule to a purified sample of CD36, CD51 or TPS. Purified CD36 may be prepared as described by Tandon et al (1989) The Journal of Biological Chemistry, 264



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pp 7570-7575. Purified CD51 may be prepared as described by Smith et al, (1990), Journal of Biological Chemistry, 265, 11008-11013 and purified TSP may be prepared as described by Silverstein et al  
5 (1985), Journal of Clinical Investigation, 75, pp 2065-2073.

Tests to detect binding of the test molecule are conveniently carried out by immobilizing the CD36, CD51 or TSP to a solid surface, for example the  
10 surface of a well of a microtitre plate. Methods of immobilization of protein molecules on such surfaces are well-known to those skilled in the art. The test molecule identified as a CD36 or CD51 agonist is then applied to the immobilized protein. Following removal  
15 of unbound test molecule the presence of bound molecule is directly detected. This may be achieved in a number of ways depending on the chemical or biochemical characteristics of the test molecule.

For example where the test molecule is a protein  
20 it would be usual to detect binding with a labelled antibody to that protein. If the test molecule is a non-antigenic small molecular weight compound then the compound itself may be radioactively labelled for detection.

25 The molecule whose activity is to be tested in the method of the invention may have any type of molecular structure. For example, it may be a protein, a peptide, an amino acid, DNA, RNA, PNA, a nucleotide or a nucleoside, or a low molecular weight  
30 compound. It may be a molecule having known pharmacological or biochemical activity or a molecule with no such known activity and may be a novel molecule. The method of the invention is suitable for testing entire libraries of molecules, for example  
35 libraries such as would be created by combinatorial chemistry. Indeed, all the embodiments of the screening method above may be adapted for an automated

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high throughput compound screen.

Using the method of the invention the present inventors are able to confirm that the *Plasmodium falciparum* derived protein pf-EMP-1 is an agonist of both CD36 and CD51. In particular a fragment of pf-EMP-1 known as CIDR/A4 which comprises the CD36 binding domain is an agonist of CD36. CIDR/A4 is described by Smith et al (1998) Molecular and Biochemical Parasitology, 97, pp 133-148 and comprises amino acids 402 to 846 of pf-EMP-1 as shown in Figure 2.

Antibodies which bind CD36 and CD51 have also been identified as having agonist activity and are capable of inhibiting the maturation of dendritic cells. Thrombospondin is also an agonist of CD51. The present invention is also directed to any individual molecule identified as an agonist of CD36 or CD51 by the methods described herein.

The assays of the invention have allowed the inventors to make the further observation that apoptotic cells, the natural ligand of CD36, are also able to inhibit dendritic cell maturation in response to LPS. This is yet further evidence of the role of CD36 in modulating immune response.

In accordance with a second aspect the invention provides a pharmaceutical composition suitable for inducing immune tolerance in a mammal which comprises an agonist of the cell surface receptor CD36 and a pharmacologically acceptable carrier or diluent. The CD36 agonist may be a molecule identified by the method described above. Agonists which are suitable for incorporation into a pharmaceutical composition in accordance with the invention for the treatment of humans include antibodies with an affinity for an epitope of CD36, in particular an antibody which blocks the binding domain on CD36 for pf-EMP-1. Monoclonal antibodies specific for CD36 which are

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designated "clone 89" and "clone SMΦ" and which are commercially available from Serotech or Immunocontact(details above) are suitable for use in the pharmaceutical compositions of the invention.

5 Other commercially available CD36 antibodies which may be included in pharmaceutical compositions are listed in Appendix 1. It is contemplated that compositions comprising antibodies bispecific against CD36 and CD51 will be useful for inhibiting dendritic cell  
10 maturation.

Other agonists suitable for inclusion in pharmaceutical compositions are all variants of the *Plasmodium falciparum* pf-EMP-1 or fragments of such proteins which comprise the binding domain for CD36.  
15 A particular example is the fragment CIDR/A4 described herein comprising amino acids 402 to 846 of pf-EMP-1. (Figure 2).

Pharmaceutical compositions comprising a bispecific CD36 antibody and the CIDR/A4 fragment are  
20 also contemplated in accordance with the invention.

Yet another agonist suitable for inclusion in a pharmaceutical composition are negatively charged phospholipids such as phosphatidylserine containing liposomes which have also been shown to bind to CD36  
25 and other cellular receptors of immune cells.

Yet another agonist suitable for inclusion in a pharmaceutical composition are apoptotic cells.

In a third of its aspects the invention provides a pharmaceutical composition suitable for inducing  
30 peripheral immune tolerance in a mammal which comprises an agonist of the cell surface receptor CD51 as expressed by mammalian dendritic cells and a pharmacologically acceptable carrier or diluent. As with CD36 acceptable agonists are antibodies,  
35 preferably monoclonal antibodies, directed against an epitope of CD51. Particularly suitable are antibodies blocking the binding domain of CD51 for the bridging

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molecule TSP. Antibodies suitable for incorporation in a pharmaceutical composition in accordance with this aspect of the invention are commercially available and set out in Appendix 2.

5           Thrombospondin (TSP) is also suitable for incorporation into a pharmaceutical composition as a CD51 agonist. Preferably, such compositions also include the *Plasmodium falciparum* protein pf-EMP-1 or a fragment thereof incorporating the thrombospondin  
10 binding domain of pf-EMP-1.

          As with CD36, negatively charged phospholipids such as phosphatidylserine are also suitable for incorporation as CD51 agonists in pharmaceutical compositions of the invention as well as apoptotic  
15 cells.

          Pharmaceutical compositions in accordance with the second and third aspects of the invention are useful for the treatment of autoimmune diseases associated with inappropriate dendritic cell  
20 maturation and T-cell proliferation such as systemic lupus erythromatosis, rheumatoid arthritis, autoimmune haemolytic anaemia or idiopathic thrombocytopenic purpura. Vehicles suitable for delivery of pharmaceutically active substances are known to those  
25 skilled in the art, especially those for delivery of pharmaceutically active proteins.

          In accordance with a fourth aspect of the invention there is provided a method of treating mammalian dendritic cells *in vitro* to induce immune  
30 tolerance therein which comprises exposing said cells to an agonist of cell surface receptors CD36 and/or CD51 as expressed on mammalian dendritic cells. The invention also relates to preparations of cells so treated. Suitable agonists are any of those agonists  
35 described above or any molecule or substance identified by the screening method described herein.

          Treatment of dendritic cells *ex-vivo* with an

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agonist of CD36 and/or CD51 is beneficial in many therapeutic applications as described hereinafter. For example, in the case of bone marrow transplantation or lymphocyte infusion recipient cells removed from the body are treated with agonists as described above to induce a state of immune tolerance therein. The treated cells are then re-introduced to the body before or simultaneously with the donor cells and the risk of allogeneic reaction is thereby reduced or eliminated. It is contemplated that dendritic cells of the donor may also be treated with a CD36 and/or CD51 agonist to induce immune tolerance. The donor may be allogeneic or xenogeneic.

The present inventors have demonstrated that in mice tolerance to foreign antigens can be achieved by exposure of dendritic cells from one mouse strain, *ex-vivo*, to a CD51 agonist followed by introduction of the treated cells into another strain of mice. Thus such therapy is expected to be applicable to humans.

In addition the present inventors have shown using a fragment of the  $\alpha$ -subunit of the human acetylcholine receptor that immature dendritic cells treated with a CD36 agonist can be "modulated" to induce tolerance against a specific antigen by subsequent *ex-vivo* exposure to that antigen. Once reintroduced *in vivo*, immune response to that antigen is reduced or avoided. Thus, dendritic cells may be removed from a patient suffering from an auto-immune disease, for example, and exposed to a CD36 and/or CD51 agonist and an antigenic molecule associated with the auto-immune disease in question and the dendritic cell preparation, with or without maturation, reintroduced into the patient. Alternatively, this method may be used to induce tolerance to a particular allo or xeno-antigen or other therapeutic substance which is likely to induce an unwanted immune response,

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such as a blood product like factor VIII.

Thus, the invention includes preparations of dendritic cells tailored to the treatment of a particular auto-immune disease by exposure to an agonist of CD36 and/or CD51 and the specific auto-antigen associated with the disease and cell preparations tolerant to other antigens likely to generate an unwanted immune response.

It follows from the inventor's observations concerning inhibition of maturation of dendritic cells with agonists of CD36 and CD51 that a similar effect will be observed with agonists of thrombospondin receptors in general and with other antigen-presenting cells of the immune system which also express CD36 and CD51 and thrombospondin receptors such as macrophages, B-lymphocytes and monocytes.

Thus, in accordance with a fifth aspect the invention provides a method of identifying a molecule which is an agonist of cell surface receptors CD36 and/or CD51 and/or a thrombospondin receptor as expressed on antigen-presenting cells of the mammalian immune system which method comprises:

- a) exposing mammalian antigen-presenting cells to the molecule to be tested,
- b) exposing said cells to an immune stimulus and
- c) determining the response to said immune stimulus by said cells,

wherein an impaired response compared to the response in the absence of said test molecule is an indication that said molecule under test is a CD36 and/or CD51 agonist or an agonist of a thrombospondin receptor.

Preferably, the response that is measured is maturation of said antigen presenting cell. Such a

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screening method may be carried out using the general methodology already described herein for dendritic cells. For example, monocytes can be purified from peripheral blood by adherence of PBMC to plastic dishes. Non-adherent cells are removed and the adherent cells can be detached by incubation with EDTA in PBS. Contaminating lymphocytes are depleted with the aid of magnetic heads and antiCD3 and antiCD19 monoclonal antibodies. Macrophages may be generated by culturing monocytes, which have been isolated as described above, in RPMI 1640 supplemented with M-CSF for six days.  $\beta$ -lymphocytes can be isolated from blood by virtue of their non-adherence to plastic petri dishes. The non-adherent cells are subjected to depletion of contaminating monocytes and T-cells by exposure to magnetic heads and antiCD14 and antiCD3 monoclonal antibodies.

Once isolated the antigen presenting cells are exposed to a substance to be tested for agonist activity against CD36, CD51 or a thrombospondin receptor and the degree of activation of said cells is measured. As with dendritic cells, activation may be determined by measuring the levels of secretion of various cytokines, or by testing ability of said antigen presenting cells to stimulate T-cell proliferation. In a preferred embodiment the increased expression of certain cell surface receptors is used as a measure of activation. In the case of monocytes and macrophages activation is accompanied by an increase in surface expression of HLA-DR, CD54 and CD86 which is measured in the manner described above, preferably with the use of a monoclonal antibodies to HLA-DR, CD54 and CD86. B-cell activation is determined by measuring the level of cell surface expression of HLA-DR, CD86 and CD40. The expression may be detected using antibodies to these cell surface receptors. Such as clone BF1, Serotech (HLA DR) clone

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BU63, Serotech (CD86) and clone TRAP1 (Pharmingen) (CD40).

5 The invention also further relates to uses of an agonist as identified above using said antigen-presenting cells for treatment of any of the auto-immune diseases listed above and for inducing immune tolerance in said antigen presenting cells ex-vivo as well as to antigen-presenting cell preparations which have been treated with a CD36 and/or CD51 agonist  
10 and/or thrombospondin receptor agonist and optionally an antigenic material.

The invention also relates to pharmaceutical compositions comprising an agonist of a thrombospondin receptor, for example  $\alpha_v\beta_3$  or  $\alpha_v\beta_5$ , with a  
15 pharmaceutically acceptable carrier or diluent suitable agonists include antibodies to the thrombospondin binding domain of said receptor, for example any of the antibodies listed in Appendix 3.

20 Other suitable agonists include negatively charged phospholipids such as phosphatidylserine containing liposomes.

It is a further conclusion from the work of the present inventors that agonists of  $\beta$ -integrin associated with the cell surface receptor CD51 as  
25 expressed on the surface of antigen-presenting cells of the mammalian immune system, will also be useful for inducing immune tolerance. The invention in a sixth aspect thus, further relates to methods of identifying  $\beta$ -integrin agonists by any of the  
30 procedures described above and to uses of  $\beta$ -integrin agonists, as defined above, for any of the medical uses which are described herein.

In a seventh aspect the present invention further relates to uses of apoptotic cells as a medicament for  
35 inducing immune tolerance in antigen-presenting cells, preferably dendritic cells and to pharmaceutical compositions comprising those cells in a suitable



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carrier or diluent. Apoptotic cells are suitable for delivering tissue specific antigens including major and minor histocompatibility antigens to dendritic or other antigen-presenting cells. Delivering antigens in this way allows delivery of unknown antigens or antigens where the class II restricted epitope(s) are not defined. The tissue origin of the apoptotic cell may be varied depending upon the application. For example, it is preferred for the apoptotic cell to be of the same tissue type as any cell bearing an antigen to which tolerance is to be induced.

In accordance with an eighth aspect the invention further relates to the use of negatively charged phospholipids for inducing immune tolerance in antigen presenting cells. Said immune tolerance may be induced by treatment of said antigen presenting cells, for example dendritic cells, with said negatively-charged phospholipid either ex-vivo by the methods described herein or by administration of the phospholipid to a patient by any of the conventional administration routes known to those skilled in the art. A preferred form of composition is liposomes comprising the negatively charged phospholipid. A preferred phospholipid is phosphatidylserine.

Since the inventions of the present application were developed following the basic observation that *Plasmodium falciparum* infected erythrocytes adhere to dendritic cells and inhibit the maturation thereof it follows that molecules which block or inhibit such adherence may be useful as pharmaceuticals in the clinical management of malaria, in particular molecules which inhibit adherence of parasite-infected erythrocytes to CD36 or TSP.

Thus, in accordance with a ninth aspect of the invention a method comprising the following steps is used to identify a molecule capable of preventing adherence of erythrocytes infected with a malarial

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parasite to human dendritic cells:

(a) exposing a purified preparation of CD36 or  
TSP to:-

- 5 (i) the molecule to be tested and  
(ii) parasitised human erythrocytes

either consecutively or simultaneously and

10 (b) determining the level of adherence of said  
parasitised erythrocytes to said CD36 or TSP

wherein a reduction in the level of adherence to CD36  
or TSP in the presence of the test molecule compared  
to the level of adherence in the absence of said test  
15 molecule is an indication that said molecule is  
capable of preventing the adherence of erythrocytes  
infected with the malarial parasite to human dendritic  
cells.

The erythrocytes may be infected with *Plasmodium*  
20 *falciparum* or another *Plasmodium* species. Suitable  
*falciparum* strains include ITO/A4 or ITO/C24 which may  
be derived as described by Roberts et al (1992) Nature  
357 pp 689-692 or Malayan Camp (MC) which may be  
obtained as described by Roberts et al (1985) Nature  
25 318:64-66.

A suitable format for carrying out a screening  
method as described above is to immobilize the  
purified CD36 or TSP onto a solid surface.  
Preferably, immobilization is secured by adsorption of  
30 the protein molecules to a plastic surface such as a  
petri dish. Parasitised erythrocytes suspended in a  
suitable binding medium are added to the adsorbed CD36  
or TSP and incubated for a period sufficient to allow  
adherence, for example, about 1 hour. Thereafter the  
35 binding medium and any non-adhered erythrocytes are  
removed and a suitable erythrocyte stain for example,  
Giemsa, added to the petri dish. Adhered erythrocytes

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may be quantified by counting under a light microscope. Alternatively, depending on the stain used, erythrocyte adherence may be quantified by spectrometry, fluorescence microcopy and the like.

5           In a tenth aspect the invention provides a method of identifying a molecule capable of preventing the adherence of red blood cells infected with a malarial parasite to human dendritic cells which comprises:

10          a) exposing immature human dendritic cells to the *Plasmodium falciparum* protein pf-EMP-1 or an active binding domain thereof in the presence or absence of the molecule to be tested,

15          b) exposing said immature dendritic cells to an immune stimulus and

            c) determining the degree of maturation manifested by said dendritic cells,

20           wherein any maturation of said dendritic cells in the presence of the test molecule over and above that manifested in the absence of said molecule is an indication that said molecule is capable of preventing  
25          adherence of red blood cells infected with a malarial parasite to human dendritic cells.

            Maturation of dendritic cells may be measured by any of the methods already described herein. Suitable immune stimulants include LPS, TNF $\alpha$ , CD40L and  
30          monocyte conditioned medium (MCM). Preferably the pf-EMP-1 preparation for use in the method is that designated in pf-EMP-1 A4var as described by Smith et al (see before) and having the Genbank Accession No. L42244. The fragment CIDR/A4 may also be used.

35           In a further aspect the invention provides for use of molecules identified by the aforementioned methods which inhibit infected erythrocyte adherence

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to dendritic cells in pharmaceutical compositions for the treatment of malarial infection.

Based on the present inventors' observations it is further contemplated that a modified CIDR region of the pf-EMP-1 A4 variant protein could be incorporated in a multisubunit vaccine against *falciparum* malaria. This would induce blocking antibodies against the CD36 binding domain of pf-EMP-1 variant proteins so that the immune responses against other proteins are not inhibited.

All documents cited in this application are incorporated herein by reference.

The invention will now be further described with reference to the following Figures and Examples.

FIGURE 1 shows schematically the molecular basis for the binding of *Plasmodium falciparum* infected red blood cells to CD36 and TSP on the surface of dendritic cells;

FIGURE 2 shows the amino acid sequence of the pf-EMP-1 fragment CIDR/A4;

FIGURE 3 shows the increase in surface expression of dendritic cell marker antigens HLA DR, CD54, CD40, CD80, CD83 and CD86 following immune stimulation after exposure to (a) LPS matured dendritic cells, (b) dendritic cells matured with LPS, with and without prior exposure to RBC, (c) dendritic cells matured with LPS with and without prior exposure to parasite lysate and (d) dendritic cells matured with LPS with and without prior exposure to intact ITO/A4 infected RBC;

FIGURE 4; (A) shows the absolute binding of erythrocytes infected with parasite lines ITO/A4, ITO/C24, MC and T9/96 to CD54, CD56, and TSP (a,c,e,g)

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and (B) shows the increase in surface expression of LPS matured dendritic cells compared with dendritic cells exposed to the respective parasite line prior to maturation (b,d,f,h);

5

FIGURE 5 shows transmission electron micrographs illustrating the interaction of dendritic cells with (a) ITO/A4 infected erythrocytes and (d) non-adherent T9/96 infected erythrocytes;

10

FIGURE 6 shows dendritic cell stimulation of T-cell proliferation (a) induced by immature dendritic cells (■), LPS-matured dendritic cells (□) and dendritic cells co-cultivated with intact ITO/A4 infected erythrocytes (▼) prior to maturation, primary CD4+ T-cell responses to parasite lysate (b) and to keyhole limpit haemocyanin (c) induced by LPS-matured autologous dendritic cells (□,○) and autologous dendritic cells co-cultivated with intact ITO/A4 infected erythrocytes (■,●) prior to maturation;

15

20

FIGURE 7 shows the effect of monoclonal antibodies against CD36 and CD51 on maturation of dendritic cells represented graphically as relative increase in surface expression of dendritic cells matured with LPS compared with immature dendritic cells;

25

FIGURE 8 shows the effect of monoclonal antibodies against CD36 and CD51 on dendritic cell maturation as a FACscan output;

30

FIGURE 9 shows further results of experiments with apoptotic cells (a) output of FACscan, (b) staining with potassium iodide to exclude dead cells, (c) proliferation of allogenic T-cells stimulated by increasing numbers of immature dendritic cells, (◆) LPS-matured dendritic cells (▲) or dendritic cells

35

- 25 -

exposed to apoptotic dendritic cells and then matured with LPS(■).

5 FIGURE 10 shows the effect of apoptotic neutrophils on the maturation of dendritic cells;

FIGURE 11 shows results of a T-cell proliferation assay including antigen specific T-cell proliferation. (a) Proliferation of allogeneic T-cells. (b) proliferation of KLH specific CD4+CD45RO- autologous T-cells (c, d) proliferation of the T-cell clone TB-2 specific for the human Acetylcholine Receptor  $\alpha$ -subunit in response to polypeptide (c) or peptide (d). Stimulator dendritic cells were treated as follows:

10 immature DC alone (\*) or matured with LPS (□); dendritic cells exposed to irrelevant antibodies with (○) or without (●) antigen and then matured with LPS; dendritic cells exposed to antiCD36 antibody with (▽) or without (▼) antigen and then matured with LPS;

15 dendritic cells exposed to antiCD51 antibody with (Δ) or without (▲) antigen and then matured with LPS; dendritic cells exposed to antiCD36 and antiCD51 antibody with (◇) or without (◆) antigen and then matured with LPS.

25 FIGURE 12 shows secretion of cytokines  $\text{TNF}\alpha$ , IL12p70 and IL10 by dendritic cells exposed to an antiCD36 antibody or to apoptotic dendritic cells and respective controls;

30 FIGURE 13 shows *in vitro* maturation of mouse dendritic cells following exposure to an antiCD51 antibody; and

FIGURE 14 shows results from mouse popliteal lymph node assay.

35

EXAMPLE 1

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**Generation of antigen-presenting cells****(a) Dendritic cells**

Immature dendritic cells were derived from peripheral  
5 human blood cells using standard procedures as  
described by Sallusto et al (1995) J. Exp. Med. 182  
pp 389-400. Briefly, monocytes were cultivated in  
RPMI 1640 supplemented with 2mM Glutamine, 50 µg/ml  
Kanamycin, 1% nonessential amino acids (GibcoBRL), 10%  
10 human AB serum and 50 ng/ml of each IL-4 (specific  
activity  $> 2 \times 10^6$  U/mg, PeproTech) and GM-CSF (specific  
activity  $> 1 \times 10^7$  U/mg, Schering-Plough) for 6 days.  
Between day six and day nine of the culture non-  
adherent immature dendritic cells were harvested and  
15 purified by depletion of contaminating lymphocytes  
with the aid of magnetic beads (Dynal) and anti-CD3  
and anti-CD19 monoclonal antibodies (DAKO).

**(b) Monocytes**

20 Monocytes were purified from peripheral blood by  
adherence of PBMC to plastic dishes for 2 hours. Non  
adherent cells were removed and the adherent cells  
layer washed 2 times with warm PBS. For further  
25 purification, the adherent cells were detached by  
incubation with 2 mM EDTA in PBS for 20 min and  
contaminating lymphocytes depleted with the aid of  
magnetic beads (Dynal or Miltenyi) and anti-CD3 and  
anti-CD19 monoclonal antibodies (DAKO).

30

**(c) Macrophages**

Monocytes isolated as described above were cultured in  
RPMI 1640 supplemented with 2 mM Glutamine, 50 µg/ml  
35 Kanamycin, 10% human AB serum and 50 ng/ml of M-CSF  
(specific activity  $> 2 \times 10^6$  U/mg, Peprotech) for 6

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days.

**(d) B-lymphocytes**

5 B-lymphocytes were isolated from human blood according to standard procedures. Briefly, non-adherent PBMC were subjected to depletion of contaminating monocytes and T-cells with the aid of magnetic beads (DynaI or Miltenyi) and anti-CD14 and anti-CD3 monoclonal  
10 antibodies (DAKO). B-cells were cultured in RPMI 1640 supplemented with 2 mM Glutamine, 50 µg/ ml Kanamycin, 1% to 10% human AB serum.

**(e) CD34+ Cells**

15 CD34+ cells were isolated from PBMC with the aid of anti-CD34 antibody conjugated magnetic beads (DynaI or Miltenyi). CD34+ progenitor were then cultured in RPMI 1640 supplemented with 2 mM Glutamine, 50 µg/ ml  
20 Kanamycin, 1% to 10% human AB serum and the following cytokines: 100 ng/ml of GM-CSF (Schering-Plough), 50 ng/ml TNFα and 50 ng/ml SCF (Peprotech) for 12 days. As an alternative, CD34+ cells could be expanded in the above mentioned medium but supplemented with 25  
25 ng/ml FLT3-L , 10U/ml TPO, SCF 20 ng/ml (Peprotech) for up to 8 weeks and then induced to differentiate to dendritic cell by culture of a further 3 days in medium supplemented with 25 ng/ml GM-CSF and 25 ng/ml IL-4."

30

**EXAMPLE 2**

**Maturation assay**

35 (a) For maturation assays  $1 \times 10^6$  purified dendritic cells were incubated in duplicate wells (a) with



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100 ng/ml LPS, (b) with 100ng/ml LPS with or without  
prior exposure to  $1 \times 10^8$  RBC, (c) with 100 ng/ml LPS  
with or without prior exposure to parasite lysate  
corresponding to  $1 \times 10^8$  parasite infected RBC, (d) 100  
5 ng/ml LPS with or without prior exposure to  $1 \times 10^8$   
intact ITO/A4 infected RBCs. Incubation with LPS  
(*Salmonella typhimurium*) was for a period of 48 hours.

Maturation of the dendritic cells was measured using  
10 monoclonal antibodies to the following human cell  
surface markers: CD3 clone OKT3, HLA A,B,C clone  
W32/6, CD14 clone Tuk4, CD54 clone 6.5B5, CD19 clone  
HD37 (DAKO): CD36 clone 89 (IgG1) or clone SMQ(IgM),  
CD80 clone BB1, CD40 clone LOB7/6, CD86 clone BU63,  
15 HLA DR clone BF-1 (Serotec), CD83 clone HB15a (Zhou et  
al (1995) J. Imm. 154, pp3821-3835. Staining of  
dendritic cells was performed as described by Zhou et  
al above and immunofluorescence analysed by FACScan  
(Becton Dickenson). All experiments were repeated at  
20 least six times with dendritic cells obtained from  
different donors. Dead cells were excluded from  
analysis using Propidium Iodide. The results are  
shown on Figure 3. The relative increase of surface  
expression is expressed as the mean fluorescence  
25 intensity (MFI) of matured dendritic cells over the  
MFI on immature dendritic cells.

The results show that dendritic cell maturation is  
inhibited by the direct interaction with intact  
30 infected erythrocytes and is not due to the secretion  
of inhibitory parasite products or a toxic effect of  
parasite debris.

The differences in surface expression on dendritic  
35 cells exposed to intact infected erythrocytes to  
dendritic cells alone are statistically significant  
for all markers with  $p < 0.01$  (Student t-test).

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**(b) Other antigen-presenting cells**

For maturation assays  $1 \times 10^6$  purified monocytes or macrophages were incubated in duplicate wells with or without LPS in the presence of medium alone, antibodies such as anti-CD36 or anti-CD51 or control antibodies, apoptotic cells or necrotic cells. Maturation was measured by the increase in surface expression of HLA-DR, CD54 and CD86 using the antibodies and flow cytometry as described above.

For maturation assays  $1 \times 10^6$  purified B-cells were incubated in duplicate wells with or without LPS in the presence of medium alone, antibodies such as anti-CD36 or anti CD51 or control antibodies, apoptotic cells or necrotic cells. Activation was measured by the increase in surface expression of HLA DR (clone BF-1, Serotec), CD86 (clone BU63, Serotec) and CD40-Ligand (clone TRAP1, Pharmingen) and flow cytometry.

**EXAMPLE 3****Cultivation of Plasmodium falciparum infected red blood cells**

Laboratory strains of Plasmodium falciparum were cultured in human RBC as described by Trager et al (1976) Science. 193 pp673 to 675. The cytoadherent cell lines ITO/A4 and ITO/C24 were clones isolated by manipulation from the ITO4 line, which is derived from a parasite isolate from Ituxi in Brazil. The cytoadherent parasite line Malayan Camp (MC) and the non-adherent cell line T9/96 were both adapted to in vitro culture from parasites originally isolated from Thailand.. All cultures were free from mycoplasma contamination. Infected erythrocytes were purified

- 30 -

either by differential sedimentation in Plasmagel or through 65% Percoll both of which gave a yield of more than 90% infected erythrocytes. Examination of a thin film revealed that more than 90% of infected erythrocytes were viable. Parasite lysate was obtained by three rounds of freezing and thawing of mature infected RBC. Parasite pigment was prepared as described by Schwarzer et al (1994) BR. J. Haematol. 88, pp740-745. Parasite conditioned medium was the supernatant derived after culturing  $1 \times 10^8$  purified infected erythrocytes in dendritic cell medium for 24 hours. All materials were from Sigma unless otherwise stated.

#### 15     **EXAMPLE 4**

##### **Binding of parasites to purified proteins**

Binding of parasitised RBCs to purified proteins was measured as previously described by Craig et al (1997) Infect. Immun. 65, pp 4580-4585. Briefly, two microlitres of a solution of TSP (Gibco-BRL), purified CD36 or purified CD54 (ICAM-Fc) were adsorbed onto bacteriological, plastic plates. Mature erythrocytes parasitised with *P. falciparum* strains (a) ITO/A4, (c) ITO/C24, (e) MC and (g) T9/96, were suspended in binding medium and added to each dish. The erythrocytes were allowed to settle and then resuspended by gentle rotation every 10 minutes for 1 hour. Non-adherent cells were removed, the remaining cells fixed and stained with Giemsa. Adherent parasitised cells were counted by light microscopy and the number of cells bound per square millimeter were corrected to binding at 2% haematocrit and 5% parasitaemia. The results are shown in Figure 4A and confirm that like ITO/A4, ITO/C24 and MC are able to

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adhere to CD36 and TSP. However, their adherence to CD54 was much reduced. T6/96 does not adhere to CD54, CD36 or TSP.

## 5 **EXAMPLE 5**

### **Effect of parasite strains on maturation**

10 A maturation assay as described in Example 2 was carried out but exposing immature dendritic cells to erythrocytes infected with (b) ITO/A4, (d) ITO/C24, (f) MC and (h) T9/96. The results are shown in Figure 4B. While parasite lines MC and ITO/C24 inhibited the maturation of dendritic cells in a similar vein to  
15 clone ITO/A4, the non-adherent line T9/96 did not inhibit maturation of dendritic cells even at a ratio of infected erythrocytes to dendritic cells of 100:1.

## 20 **EXAMPLE 6**

### **Electron microscopy**

Adherence of ITO/A4 infected erythrocytes but not T9/96 infected erythrocytes to dendritic cells was  
25 confirmed by electron microscopy. One million purified immature dendritic cells were incubated for 2 hours and for 12 hours with  $1 \times 10^8$  ITO/A4 infected RBC (a) or T9/96 infected (d) in 2 ml of dendritic cell medium, harvested and fixed with 2.5%  
30 glutaraldehyde/cacodylate buffer. Cells were post fixed in osmium tetroxide, dehydrated and embedded in epoxy resin. Thin sections were stained with uranyl acetate and lead citrate prior to examination in a Joel 1200EX electron microscope. The number of  
35 adherent and infected erythrocytes and the number of phagosomes containing pigment granules was counted in

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each sample in thin sections of 100 randomly selected dendritic cells. Transmission electron micrographs are shown in Figure 5.

- 5 Note the cell processes partially enclosing infected erythrocytes (arrows in a) and the close apposition of the limiting membranes of the infected erythrocytes and dendritic cells particularly at the knobs (b, arrowhead). Within dendritic cell cytoplasm are  
10 phagosomes containing characteristic pigment granules (c, arrows). N - dendritic cell nucleus, P - infected erythrocyte. Bars are 2  $\mu$ m (a and d), 200  $\mu$ m (b), 500  $\mu$ m (c).
- 15 ITO/A4 infected erythrocytes were observed to be in intimate contact with immature dendritic cells with cytoplasmic processes partially enclosing the parasites (Fig. 5a). The plasmalemma of the infected erythrocytes was in close apposition to the limiting  
20 membrane of the dendritic cell particularly at the site of knobs (Fig. 5b). A similar apposition between parasitised erythrocytes and host cells is seen between infected red blood cells and endothelial cells (Berendt et al (1994) *Parasitology* 108 Suppl. 519-28).  
25 In contrast, only a few infected erythrocytes of the T9/96 strain were associated with the dendritic cells (Fig. 5d). When quantified, ten times more ITO/A4 infected erythrocytes were found adherent to dendritic cells than T9/96 infected erythrocytes in 100 thin  
30 sections of dendritic cells. Furthermore, ingestion of intact ITO/A4 infected erythrocytes by dendritic cells was not observed during this time. Nevertheless, phagocytosis of parasite debris as revealed by the number of phagosomes containing pigment granules (Fig.  
35 5c) was similar for dendritic cells incubated with ITO/A4 or with T9/96.

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**EXAMPLE 7****T-cell proliferation assays**

5 Total-T-cells (allogeneic MLR) or CD4+ T cells  
(primary T-cell responses) were purified using a  
Collect column (TCS). For the allogeneic MLR,  
dendritic cells were added in increasing numbers (156  
to 10,000) to  $1 \times 10^5$  T-cells in triplicate and  
10 incubated for 5 days. T-cells were pulsed with 0.5  $\mu$ Ci  
 $^3$ H-thymidine/well for the last 18 hours of the  
culture. For primary T-cell responses,  $1 \times 10^6$   
dendritic cells were incubated with medium alone or  
with  $1 \times 10^8$  infected erythrocytes for 18 h and then  
15 pulsed with 10  $\mu$ g/ml parasite-lysate or with 30  $\mu$ g/ml  
keyhole limpet haemocyanin, respectively. The  
dendritic cells were purified by sedimentation through  
Lymphoprep™ and  $1 \times 10^5$  dendritic cells were culterd  
with  $1.5 \times 10^6$  CD4+ T-cells from the same donor. From  
20 day 4 to day 6 of culture, 50  $\mu$ l aliquots were taken  
in triplicate and pulsed with 0.5  $\mu$ Ci  
 $^3$ H-thymidine/well for 8 hours.  
(see Plebanski et al (1992) Immunol. 75 86-90). The  
results are shown in Figure 6.

25 Dendritic cells exposed to intact infected  
erythrocytes are poor stimulators of T-cell  
proliferation. Allogeneic T-cell proliferation (a)  
induced by immature dendritic cells (■), LPS-matured  
30 dendritic cells (□) and dendritic cells co-cultivated  
with intact ITO/A4 infected erythrocytes (▼) prior to  
maturation. Primary CD4+ T-cell responses to  
parasite-lysate (b) and to keyhole limpet haemocyanin  
(c) induced by LPS-matured autologous dendritic cells  
35 (□,○) and autologous dendritic cells co-cultivated  
with intact ITO/A4 infected erythrocytes (■,●) prior

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to maturation. Data from one out of three independent experiments are shown.

Dendritic cells matured after incubation with uninfected RBC, a crude pigment preparation or a lysate of infected erythrocytes induced a similar degree of T-cell proliferation in a mixed leukocyte, reaction to that induced by control mature dendritic cells (data not shown).

However, dendritic cells incubated with LPS after exposure to intact infected erythrocytes from the parasite line ITO/A4 were strikingly less efficient in their induction of T-cell proliferation compared with the T-cell proliferation induced by mature dendritic cells (Fig 6a). Furthermore, dendritic cells exposed to intact infected erythrocytes before maturation with LPS did not induce primary CD4+ T-cell responses to lysate of infected erythrocytes or to keyhole limpet haemocyanin (Plebanski et al) (Fig 6, b,c).

It is concluded that the maturation of dendritic cells and their subsequent ability to activate T-cells is profoundly inhibited by their interaction with intact infected erythrocytes. Non-adherent parasite lines, parasite debris and crude pigment do not modulate dendritic cell function in this way. These studies provide one explanation for the clinical and experimental evidence of immune dysregulation during malaria infection such as the impairment of the delayed-type hypersensitivity response to recall antigens and the antibody response to vaccines.

#### **EXAMPLE 8**

##### **Maturation assay with monoclonal antibody**

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A maturation assay was carried out as described in Example 2 except that instead of infected erythrocytes the immature dendritic cells were exposed to monoclonal antibodies to CD36, CD51 or both prior to immune stimulation with LPS. Specifically,  $1 \times 10^6$  purified dendritic cells were incubated in duplicate wells without or with either 25  $\mu$ g irrelevant IgM antibody, 25  $\mu$ g irrelevant IgG1 antibody, 25  $\mu$ g antiCD36 antibody, 25  $\mu$ g antiCD51 antibody or a combination thereof for at least 3 hours. Thereafter, dendritic cells were matured with 100 ng/ml LPS (*Salmonella typhimurium*) for 48 hours or left untreated as a control. The monodonal antibodies tested were CD36 clone SMQ (Immunocontact) and clone 89 (Serotec), CD51 clone 13C2 (Immunocontact), IgM isotope control clone MOPC, IgG isotope control clone MOPC (Sigma). The results of two experiments are shown in Figures 7 and 8 respectively. As will be apparent both CD36 and CD51 antibodies have the effect of inhibiting dendritic cell maturation in a similar manner to infected erythrocytes.

#### EXAMPLE 9

25

#### Maturation assay with apoptotic cells

A maturation assay was carried out as described in Example 2 except that instead of infected erythrocytes the immature dendritic cells were exposed to apoptotic cells prior to immune stimulation with LPS. Apoptotic or necrotic cells were derived from purified autologous dendritic cells, monocytes or neutrophils. Specifically for maturation assays in the presence of apoptotic bodies  $1 \times 10^6$  purified dendritic cells were incubated in



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duplicate wells without or with either  $2 \times 10^6$  autologous apoptotic or necrotic cells for 12 hours. Maturation was induced by the addition of LPS or  $\text{TNF}\alpha$  as stated above. Apoptosis was induced by radiation with a calibrated UV lamp at a dose of  $2500 \text{ mJ/cm}^2$  and evaluated by staining with FITC-AnnexinV/Propidium Iodide according to manufacturers recommendations (Roche Diagnostics) 3 hours and 12 hours after UV radiation. Necrosis was induced by at least three cycles of rapid freezing at  $-70^\circ\text{C}$  and thawing at  $37^\circ\text{C}$ . Thereafter, more than 90% of cells were permeable for trypan blue. The results are shown in Figure 9 as follows:

Apoptotic cells but not necrotic cells inhibit the maturation of dendritic cells. (a) Immature dendritic cells were left untreated, matured with LPS or exposed autologous apoptotic or necrotic dendritic cells prior to maturation with LPS and subsequently stained with antibodies directed against surface marker and analysed by FACScan as indicated. (b) Dead Cells and especially apoptotic cells were efficiently excluded from analysis by gating on forward scatter and exclusion of cells positive for Propidium Iodide. (c) Proliferation of allogeneic T-cells stimulated by increasing numbers of immature dendritic cells ( $\blacklozenge$ ), LPS-matured cells ( $\blacktriangle$ ) or dendritic cells exposed to apoptotic dendritic cells and matured with LPS ( $\blacksquare$ ).

The results of a further experiment with apoptotic neutrophils shown in Figure 10.

#### **EXAMPLE 10**

##### **Antigen specific T-cell responses**

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The proliferative response of the  $\text{CD4}^+$  T-cell clone

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TB-2 for the peptide 144-163 of the human acetylcholine receptor (Nagvekar N et al, J. Clin invest, 1998 101 (10) pp 2268-77) was analysed. T-cell proliferation was measured as described in Example 7.

5 For antigen-specific T-cell responses,  $1 \times 10^6$  dendritic cells were incubated with medium alone or with antibodies as indicated and then pulsed for 6 h with 0.025 mM AChR  $\alpha$ : 3-181 polypeptide before or 1 mM AChR  $\alpha$ :144-163 peptide after maturation with LPS.

10 For antigen specific T-cell responses of the clone TB-2 increasing numbers of MHC class II matched dendritic cells were incubated with  $3 \times 10^4$  T-cells for 72 h. Proliferation was measured in all assays by adding 0.5 mCi  $^3\text{H}$ -thymidine/well for the last 8 hours

15 of the culture.

The results are shown in Figure 11 (c) and (d). Exposure of dendritic cells to antiCD36, antiCD51 or both antibodies abolished their ability to induce

20 proliferation in the T-cell clone as compared to dendritic cells exposed to irrelevant antibodies (Fig 2c, d). The proliferation of the T-cell clone remained low even when the modulated dendritic cells were exogenously loaded with peptide thus excluding a

25 defect in antigen-uptake or antigen-processing due to the presence of antibodies.

#### **EXAMPLE 11**

##### **30 Cytokine production by dendritic cells**

Secretion of the cytokines TNF alpha, IL12 p70 and IL10 was measured in supernatants of dendritic cells treated with either anti-CD36 antibody or apoptotic

35 cells or in the respective controls before or after maturation with LPS for 24 hours using commercially

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available ELISA kits. These kits can be obtained  
from R and D Systems, Europe Ltd. 4-10, The Quadrant,  
Barton Lane, Abingdon, Oxford, OX143 YS and BD  
Pharmingen, 10975, Torreyana Road, San Diego, CA  
5 92121, USA.

Maturation with LPS induced secretion of TNF- $\alpha$  by  
dendritic cells irrespective whether they were exposed  
to anti-CD36 antibodies or apoptotic cells although the  
10 concentration of TNF- $\alpha$  was consistently slightly lower  
than in the respective controls. IL12 p70 was secreted  
by control dendritic cells matured with LPS whereas  
IL10 was secreted by dendritic cells exposed to anti-  
CD36 antibodies or apoptotic cells. Of note, the  
15 absolute amount of IL10 varied considerably between  
dendritic cells treated with anti-CD36 and dendritic  
cells exposed to apoptotic cells in response to LPS. It  
is possible that intact cells bind to more than one  
receptor thus modifying the cytokine secretion induced  
20 by CD36 alone. However, we investigated whether  
secretion of IL10 had a role in inhibition of dendritic  
cell maturation due to ligation of CD36 by maturing  
dendritic cells exposed anti-CD36 antibodies or to  
apoptotic cells in the presence of blocking anti-IL10  
25 antibodies. The inhibition of dendritic cell maturation  
was not reversed (data not shown) and is therefore  
independent of the secretion of IL10.

## EXAMPLE 12

30

### **Modulation of mouse dendritic cell maturation and function by antiCD51 antibodies *in vitro* and *in vivo***

#### Rationale

35 Since human monocyte derived dendritic cells can be  
modulated in their maturation and function by a variety

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of agents including antibodies binding to CD36 and or CD51, in this study we began to investigate whether a similar phenomenon could be observed in mouse dendritic cells.

5

#### Methods

Generation of bone-marrow derived dendritic cells: Bone marrow from male Balb/c (H-2<sup>k</sup>) mice was harvested and total cells were cultured in RPMI supplemented with 2 mM glutamine, 50 mg Kanamycin, 10 % FCS, 10 ng/ml each murine recombinant GM-CSF and IL-4. On day two of culture half the medium was replaced with fresh medium supplemented with cytokines and on day four of culture non-adherent cells were harvested.

15

In vitro maturation of bone-marrow derived mouse dendritic cells: One million of bone marrow derived dendritic cells (approximately 50% total cells) in duplicate were exposed to either medium alone, 25 mg isotype control antibody or 25 mg antiCD51 antibody for 8 hours. Cells were subsequently exposed to 100 ng LPS for 48 hours or left alone as a control. Maturation of dendritic cells was analysed by double staining with FITC conjugated antibodies against CD11c and PE-conjugated antibodies directed against either CD40, CD54, CD86 or I-A and subsequent FACScan analysis. Analysis was performed on CD11c-FITC positive cells.

25

Popliteal lymph node assay: Dendritic cells were exposed to medium alone or to antiCD51 antibodies and then matured with LPS as described above. The cells were then harvested and washed four times in PBS in order to remove LPS. Cells were resuspended in 10% FCS/PBS at a concentration of  $6 \times 10^5$  total cells/20 ml. Groups of six male C3H3/HE (H-2<sup>d</sup>) mice were injected with 20 ml of PBS into the right footpad and LPS matured dendritic cells into the left footpad, with 20 ml

30

35

- 40 -

of PBS into the right footpath and dendritic cells exposed to antiCD51 antibody prior to LPS maturation into the left footpad or with 20 ml of PBS into the right and the left footpad. After one week mice were sacrificed and the popliteal lymphnodes were removed. The weight of the left and the right lymphnode of each mouse in all three groups were determined and the ratio of the weight of the left lymphnode to the weight of the right lymphnode was calculated. The mean and SE of the ratio was determined for each group.

### Results

Dendritic cells matured with LPS (DC LPS) increased the surface expression of the molecules CD40, CD54 and CD86 as compared to immature dendritic cells (DC). However, when dendritic cells were treated with antiCD51 antibodies prior to exposure to LPS (DC CD51 lps), the dendritic cells failed to mature and the expression of surface molecules remained at the level of immature dendritic cells (DC). The antibody itself had no effect on dendritic cell maturation (DC CD51). The results are shown in Figure 13.

When dendritic cells matured with LPS were injected into the footpad of allogeneic C3H/HE mice, they induced a strong allogeneic T-cell response as measured by the increase in weight of the popliteal lymphnode of the right footpad compared to the popliteal lymphnode of the left footpad. By contrast, the increase in weight of the right popliteal lymphnode over that of the left popliteal lymphnode was markedly reduced when dendritic cells were exposed to antiCD51 antibody prior to maturation with LPS. However, the overall increase in weight was still above that of popliteal lymphnodes of mice that had been injected with PBS in both footpads. The results are shown in Figure 14.

- 41 -

**EXAMPLE 13****Modulation of human dendritic cells *ex vivo***

5 Agonists of CD36, CD51, thrombospondin receptors or  
β-integrin may be used to modulate human immune  
response in patients with unwanted and/or harmful  
allo- or auto-immune responses. For such a method of  
10 treatment immature human dendritic cells which are  
defined and identifiable as described herein and with  
the ability to phagocytose are derived from  
preparations of human peripheral blood.  
Specifically, the dendritic cells are derived from  
15 CD34+ stem cells or monocytes isolated from human  
peripheral blood by the method described in Example  
1. To the preparation of cells suspended in  
appropriate medium, for example RPMI as defined  
herein, an agonist of C36, CD51, thrombospondin  
20 receptor or β-integrin is added. The relative  
concentration of agonist to cells is adjusted  
depending on the nature of the agonist used. For  
example, if the agonist is a monoclonal antibody,  
about 25 μg antibody to about 10<sup>6</sup> dendritic cells is  
appropriate at a concentration of 25 μg Ml<sup>-1</sup>. The  
25 cells are treated for between 3 and 24 hours.

Depending on the particular application cells are  
returned to the individual from which they were  
originally derived or administered to another  
individual. Administration may be by intravenous  
30 infusion, by inhalation or by sub-cutaneous or  
intramuscular injection.

Administration of dendritic cells to a human  
following the method described above will give rise  
to a generalized immune suppressive effect which will  
35 be useful, in a number of situations, for example in  
the prevention of rejection of allografts and

- 42 -

xenografts or for treatment of disease suspected of having an auto-immune basis but for which the auto-antigen is not known.

5       However, the method described above may be modified to produce dendritic cells which are tolerant to a specific antigen. In this case the dendritic cell preparation is exposed to an antigen against which tolerance is to be induced as well as to the CD36, CD51, thrombospondrin receptor or  $\beta$ -  
10       integrin agonist. The cells may be exposed to antigenic material, before, after or simultaneously with the aforesaid agonist molecule. The antigenic material may be linked to, fused to or otherwise associated with said agonist molecule. Exposure to  
15       the antigenic material is for about 6 to about 24 hours with or without an immune stimulant, then the cells are reintroduced to the patient as described above.

20       The ability to induce tolerance to a specific antigen, for example an allo, xeno or auto-antigen allows a great many therapeutic applications. For example tolerance can be induced in respect of the following antigens:

25       to major or minor histocompatibility antigens of a recipient of a bone marrow transplant (to modulate graft versus host disease in bone marrow transplantation in dendritic cells from the bone marrow donor) or

30       to donor major or minor histocompatibility antigens in dendritic cells of recipients of solid organ transplant or

35       to antigens to which there is pathological immune response causing auto-immune diseases for example: components of autologous red blood cells to modulate

- 43 -

the immune response in patients with auto-immune  
hemolytic anaemia  
components of autologous platelets in patients with  
auto-immune thrombocytopenia components of beta islet  
5 cells of the pancreas in patients with insulin  
dependent diabetes mellitus  
components of other endocrine organs in patients with  
other organ specific auto-immune diseases  
components of the acetylcholine receptor in patients  
10 with myasthenia gravis  
other antigens or apoptotic cells containing antigens  
causing harmful or pathological immune responses in  
other auto-immune diseases  
15 to antigens to which there is pathological immune  
response causing atopic or allergic diseases, for  
example antigens eliciting an immune response in hay  
fever, asthma, eczema or coeliac disease  
20 to antigens to which there is pathological immune  
response that may be defined in other diseases for  
example in non-organ specific immune diseases  
(systemic lupus erythematosus or rheumatoid  
arthritis) or other immune mediated arthritis or  
25 other connective tissue diseases  
in inflammatory bowel disease  
in auto-immune hepatitis  
in multiple sclerosis  
or in other auto-immune disease  
30 to allo-antigens to which there is a harmful or  
pathological immune response for example  
components of red blood cells in haemolytic disease  
of the newborn or in previously transfused patients  
35 components of platelets for example in neo-natal allo  
immune thrombocytopenia or in conditions where there  
is an allo-immune response to transfused platelets



- 44 -

other blood products or substitutes for example  
Factor VIII in haemophilia patients  
other synthesized or manufactured or naturally  
occurring products or substances

5

Although the treatment of humans with dendritic  
cells is described in this example it will be  
appreciated that other antigen-presenting cells, such  
as macrophages, monocytes or  $\beta$ -lymphocytes could be  
10 used for treatment with an agonist of CD36, CD51,  
thrombospondin receptor or  $\beta$ -integrin and optionally  
an antigenic material. Specific tolerance can be  
introduced in such cells for use in any of the  
applications listed above.

15

#### **Example 14**

##### **Preparation of phosphatidylserine liposome compositions and their therapeutic uses.**

20 Liposomes containing phosphatidylserine or other  
negatively charged phospholipids, with or without  
additional targeting molecules, induce general immune  
unresponsiveness. Liposomes encapsulating antigens  
and phospholipids with or without additional  
25 targeting molecules induce antigen specific immune  
unresponsiveness.

Liposomes are prepared as described by Coradini  
et al, Anticancer Research 1998 18 177-182. In brief  
clean glass tubes are coated with 2 micromolar of  
30 mixtures of phosphatidylcholine and  
phosphatidylserine, other negatively charged  
phospholipids or other phospholipids including  
cholesterol and/or cholesterol ester dissolved in  
chloroform. The solvent is evaporated under nitrogen  
35 gas and the tubes incubated in a vacuum for 45  
minutes. Sterilised phosphate buffered saline

- 45 -

(unmodified liposomes) or containing the antigen(s) to which unresponsiveness will be induced with or without molecules allowing targeting of the liposomes to CD36 and/or CD51 and/or beta-integrins and/or other receptors of apoptotic cells or other molecules expressed on the surface of antigen presenting cells, is added to the lipid shell. Suitable targeting molecules are monoclonal antibodies to the respective receptors or fragments of the P. falciparum erythrocyte membrane protein-1 that bound to CD36 and/or thrombospondin. The tubes are shaken at high speed for 5 minutes and separated from free fatty acid by ultracentrifugation at 100,000g for 60 minutes. Targeting molecules (see above) may be covalently or non-covalently attached to the surface of liposomes. The liposomes are filtered through a 0.22 micrometer filter. Encapsulation of antigens and targeting molecules can also be achieved by freeze-thawing or dehydration/rehydration or by reverse phase evaporation (Monnard PA et al, Biochem. Biophys. Acta 1997 1329 39-50) or by other published methods of preparing liposomes.

Liposomes prepared as described above would be added to  $1 \times 10^6$  isolated immature dendritic cells or to other antigen presenting cells at a concentration of 25 micrograms per ml. The maturation and function of the dendritic cells or other antigen presenting cells is assessed as previously described. The liposomes containing phosphatidylserine (with or without targeting molecules) is used to treat dendritic cells or other antigen presenting cells ex vivo or for systemic treatment.

APPENDIX 1

DI is distributor

SD is standard designation

Other MABs are

OKM5	Ortho Pharmaceutical Corporation
OKM8	1001 US Highway 202
	P.O. Box 250
	Raritan, N.J.

cd 36 in HDB-D1 HDB-NOND1

<http://www.atcc.org/cgi-bin/Sfgat...abase=local%2FHDB-NOND1&text=cd36>

Your query was:

cd36

The selected databases contain 18 documents matching your query:

- 1: 1013396 RE 1.CE>platelet 1.SN>CD36 1.a.CC>differentia
- 2: 1003558 RE 1.CE>platelet 1.U>cell membrane 1.SN>CD36
- 3: 1018253 RE 1.SN>CD36 1.a.CC>differentiation 1.b.CC>gly
- 4: 1020319 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36
- 5: 1013397 RE 1.CE>platelet 1.SN>CD36 1.a.CC>differentia
- 6: 1020540 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36
- 7: 1017636 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36
- 8: 1022016 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36
- 9: 1019865 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36
- 10: 1024459 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36
- 11: 1019119 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36 1.MW
- 12: 1009963 RE 1.G>Homo sapiens 1.CN>human 1.CE>monocyte
- 13: 1016854 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet
- 14: 1023242 RE 1.G>Homo sapiens 1.CN>human 1.U>cell membr
- 15: 22825 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet
- 16: 1012440 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36
- 17: 1012380 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36
- 18: 1003358 RE 1.SN>ACTH 1.FS>N-terminal region 1.a.CC>ho

- 48 -

**013396 RE 1.CE>platelet 1.SN>CD36 1.a.CC>differentia**

1013396 RE 1.CE&gt;platelet 1.SN&gt;CD36 1.a.CC&gt;differentiation

AN 1013396

DI P&gt;Medica

DI 2382 Camino Vida Roble, Suite I

DI Carlsbad, CA 92009 USA

DI 1-619-438-1886

DE C&gt;CLB/703 ;developer

DE P&gt;MON1118 ;distributor

PD ;IgG1

RE 1.CE&gt;platelet 1.SN&gt;CD36 1.a.CC&gt;differentiation

RE 2.CE&gt;monocyte 2.SN&gt;CD36 2.a.CC&gt;differentiation

RE 3.CE&gt;macrophage 3.SN&gt;CD36 3.a.CC&gt;differentiation

RE 4.CE&gt;platelet 4.SN&gt;CD36 4.a.CC&gt;differentiation

AP ;frozen section

SD MON1118

LD USA BAL

EI DA&gt;9303

CI ;catalog

SN Synonym&gt;CD36 1013396 SN Synonym&gt;CD36

- 49 -

\_003558 RE 1.CE>platelet 1.U>cell membrane 1.SN>CD36

1003558 RE 1.CE>platelet 1.U>cell membrane 1.SN>CD36

AN 1003558

DI P>Biodesign International

DI 105 York Street

DI Kennebunkport, ME 04043 USA

DI 1-207-985-1944

DE P>N42540M ;distributor

PD ;IgG1

RE 1.CE>platelet 1.U>cell membrane 1.SN>CD36

RE 1.a.CC>differentiation 1.b.CC>protein

RE 1.c.CC>blood coagulation factor

AV ;purified

SD N42540M

LD USA BAL

EI DA>9002 CV>9007

CI ;catalog

SN Synonym>CD36 1003558 SN Synonym>CD36

- 50 -

**018253 RE 1.SN>CD36 1.a.CC>differentiation 1.b.CC>gl**

1018253 RE 1.SN&gt;CD36 1.a.CC&gt;differentiation 1.b.CC&gt;glycoprotein

AN 1018253

DI P&gt;BioGenex Laboratories

DI 4600 Norris Canyon Road

DI San Ramon, CA 94583 USA

DI 1-510-275-0550

DI 1-800-421-4149 (toll free USA)

DE P&gt;1E8 ;distributor

DO G&gt;Mus musculus CN&gt;mouse

RE 1.SN&gt;CD36 1.a.CC&gt;differentiation 1.b.CC&gt;glycoprotein

AV ;purified

SD 1E8

LD USA JMJ

EI DA&gt;9602

CI ;catalog

SN Synonym&gt;CD36 1018253 SN Synonym&gt;CD36

- 51 -

**020319 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36**

1020319 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

AN 1020319

DI P&gt;Harlan Bioproducts for Science, Inc.

DI P.O. Box 29176

DI Indianapolis, IN 46229-0176

DI 1-317-894-7536

DI 1-800-9-SCIENCE

DE C&gt;89 ;distributor

DE P&gt;MCA1214 ;distributor

DO G&gt;Mus musculus CN&gt;mouse

PD ;IgG2b

RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

RE 1.a.CC&gt;differentiation

AP ;flow cytometry ;Western blot

AV ;purified

SD 89

SD MCA1214

LD USA CLB

EI DA&gt;9702

CI ;catalog

SN Synonym&gt;CD36 1020319 SN Synonym&gt;CD36



**013397 RE 1.CE>platelet 1.SN>CD36 1.a.CC>differentia**

1013397 RE 1.CE>platelet 1.SN>CD36 1.a.CC>differentiation

AN 1013397

DI P>Caltag Laboratories

DI 1849 Bayshore Blvd. #200

DI Burlingame, CA 94010

DI 1-650-652-0468

DI 1-800-874-4007

DI 2.P>Medica

DI 2382 Camino Vida Roble, Suite I

DI Carlsbad, CA 92009 USA

DI 1-619-438-1886

DE C>VM58 ;developer

DE P>MON1143 ;distributor

DE P>VM58 ;distributor

DE 2.P>MON1143 ;distributor

PD ;IgG1

RE 1.CE>platelet 1.SN>CD36 1.a.CC>differentiation

RE 2.CE>monocyte 2.SN>CD36 2.a.CC>differentiation

RE 3.CE>macrophage 3.SN>CD36 3.a.CC>differentiation

RE 4.CE>platelet 4.SN>CD36 4.a.CC>differentiation

AP ;frozen section

SD VM58

LD USA BAL

EI DA>9303

CI ;catalog

SN Synonym>CD36 1013397 SN Synonym>CD36

- 53 -

**\_020540 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36**

1020540 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36

AN 1020540

DI P>Harlan Bioproducts for Science, Inc.

DI P.O. Box 29176

DI Indianapolis, IN 46229-0176

DI 1-317-894-7536

DI 1-800-9-SCIENCE

DE P>89 ;developer

DE P>MCA1214 ;distributor

DO G>Mus musculus CN>mouse

PD ;IgG2b

RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36

RE 1.a.CC>differentiation

AP ;flow cytometry ;Western blot

AV ;purified

SD 89

SD MCA1214

LD USA CLB

EI DA>9702

CI ;catalog

SN Synonym>CD36 1020540 SN Synonym>CD36

117636 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36

1017636 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36

AN 1017636

DI P>Novocastra Laboratories Ltd.

DI 24 Claremont Place

DI Newcastle upon Tyne NE2 4AA, UK

DI 44-0191 222 8550

DE P>NCL-CD36 ;distributor

DE P>SMO ;distributor

DO G>Mus musculus CN>mouse

AS ;immunohistochemical staining

RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36

RE 1.a.CC>differentiation

AP ;frozen section

AV ;ascites

SD NCLCD36

SD SMO

LD USA BAL

EI DA>9904

CI ;catalog

SN Synonym>CD36 1017636 SN Synonym>CD36

- 55 -

**022016 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36**

1022016 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

AN 1022016

DI P&gt;O.E.M. Concepts, Inc.

DI 1889 Route 9, Bldg. 25, Unit 96

DI Toms River, NJ 08755 USA

DI 1-732-341-3570

DE C&gt;289-10930 ;distributor

DE P&gt;M2-L69 ;distributor

DO G&gt;Mus musculus CN&gt;mouse

RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

RE 1.a.CC&gt;differentiation

AP ;cell surface marker

AV ;purified

SD 28910930

SD M2L69

LD USA EJK

EI DA&gt;9712

CI ;catalog

SN Synonym&gt;CD36 1022016 SN Synonym&gt;CD36

- 56 -

**019865 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36**

1019865 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

AN 1019865

DI P&gt;Upstate Biotechnology, Inc.

DI 199 Saranac Avenue

DI Lake Placid, NY 12946 USA

DI 1-617-890-8845

DI 1-800-233-3991 (toll free USA) (sales)

DE P&gt;05-287 ;distributor

DO G&gt;Mus musculus CN&gt;mouse S&gt;BALB/c O&gt;spleen

PD ;IgM

RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

RE 1.a.CC&gt;differentiation 1.b.CC&gt;protein

AP ;immunocytochemistry

AV ;ascites

SD 05287

LD USA JMJ

EI DA&gt;9611

CI ;catalog

SN Synonym&gt;CD36 1019865 SN Synonym&gt;CD36

- 57 -

016854 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet

1009963 RE 1.G>Homo sapiens 1.CN>human 1.CE>monocyte

1009963 RE 1.G>Homo sapiens 1.CN>human 1.CE>monocyte 1.SN>CD36

AN 1009963

DI P>Harlan Bioproducts for Science, Inc.

DI P.O. Box 29176

DI Indianapolis, IN 46229-0176

DI 1-317-894-7536

DI 1-800-9-SCIENCE

DI 2.P>Immunotech S.A.

DI Departement commercial

DI Luminy Case 915

DI 13288 Marseille Cedex 9, France

DI 33-91-41-41-38

DI 430246 F IMMTECH

DE C>Fa6-152 ;developer

DE P>MCA 682 ;distributor

DE 2.P>0765 ;distributor

DE 2.P>0766 ;distributor

DE 2.P>FA6.152 ;distributor

DO G>Mus musculus CN>mouse

PD ;IgG1

RE 1.G>Homo sapiens 1.CN>human 1.CE>monocyte 1.SN>CD36

RE 1.a.CC>differentiation

RE 2.G>Homo sapiens 2.CN>human 2.CE>macrophage 2.SN>CD36

RE 2.a.CC>differentiation

RE 3.G>Homo sapiens 3.CN>human 3.CE>platelet 3.SN>CD36

RE 3.a.CC>differentiation

AV ;purified ;2.fluorescein conjugate ;2.purified

SD 0765

SD 0766

SD FA6152

SD MCA682

LD USA BAL

EI DA>9103 CV>9104

CI ;catalog

SN Synonym>CD36 1009963 SN Synonym>CD36

- 58 -

**\_023242 RE 1.G>Homo sapiens 1.CN>human 1.U>cell membr**

1023242 RE 1.G>Homo sapiens 1.CN>human 1.U>cell membrane 1.SN>CD36

AN 1023242

SO Exp Cell Res 1992;198:85-92

SO J Exp Med 1990;171:1883-92

DI P>Lab Vision-NeoMarkers

DI 47770 Westinghouse Drive

DI Fremont, CA 94539 USA

DI 1-800-828-1628

DE C>1A7 ;distributor

DE P>MS-466-P ;distributor

IM G>Homo sapiens CN>human CE>platelet SN>CD36 a.CC>differentiation

IM b.CC>glycoprotein c.CC>receptor

DO G>Mus musculus CN>mouse

PD ;IgG2b ;kappa

RE 1.G>Homo sapiens 1.CN>human 1.U>cell membrane 1.SN>CD36

RE 1.MW>88 kD 1.a.CC>differentiation 1.b.CC>glycoprotein

RE 1.c.CC>receptor

AP ;flow cytometry ;immunofluorescence ;immunoprecipitation

AP ;Western blot ;immunohistology ;gold labelling

AB platelet GPIIb, platelet glycoprotein IIb, and OKM5-antigen.

SD 1A7

SD MS466P

LD USA MCM

EI DA>9806

CI ;catalog

SN Synonym>CD36 1023242 SN Synonym>CD36

1825 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet

22825 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet

AN 22825

AU Kemshead J

AD Imperial Cancer Research Technology;

AD Sardinia House;

AD Sardinia Street;

AD London WC2A 3NL;

AD UK;

AD Tel 01 242 1136;

AD TELEX 265107 TCRFG;

AD FAX 01 831 4991

SO Br J Haematol 1984;57:621

DE P>M148 ;developer

IM G>Homo sapiens 1.CN>human PA>medulloblastoma a.CC>neoplasm

PD ;IgG1

RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet

RE 1.U>cell surface 1.SN>CD36 1.MW>110-130 kD

RE 1.a.CC>differentiation

RE 2.G>Homo sapiens 2.CN>human 2.PA>medulloblastoma

RE 2.a.CC>neoplasm

RE 3.G>Homo sapiens 3.CN>human 3.PA>neuroblastoma

RE 3.a.CC>neoplasm

RE 4.G>Homo sapiens 4.CN>human 4.PA>rhabdomyosarcoma

RE 4.a.CC>neoplasm

AP ;immunofluorescence ;immunoprecipitation

AB in vivo imaging and therapy

SD M148

LD EUR BD FI>EUR0003951 EUR901.TXT

EI DA>8901 CV>8904

CI ;catalog

SN Synonym>CD36 22825 SN Synonym>CD36



- 60 -

1012380 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

1012380 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

AN 1012380  
DI P>Biodesign International  
DI 105 York Street  
DI Kennebunkport, ME 04043 USA  
DI 1-207-985-1944  
DI 2.P>Harlan Bioproducts for Science, Inc.  
DI P.O. Box 29176  
DI Indianapolis, IN 46229-0176  
DI 1-317-894-7536  
DI 1-800-9-SCIENCE  
DI 3.P>Lampire Biological Laboratories  
DI P.O. Box 270  
DI Pipersville, PA 18947 USA  
DI 1-215-795-2838  
DI 4.P>Sigma Chemical Company  
DI P.O. Box 14508  
DI St. Louis, MO 63178 9916 USA  
DI 1-800-325-3010 (toll free USA)  
DI 1-314-771-5750  
DE C>SMO ;developer  
DE P>P54168M ;distributor  
DE P>SMO ;distributor  
DE 2.P>MCA-722F ;discontinued designation  
DE 2.P>MCA722 ;distributor  
DE 2.P>SMO ;distributor  
DE 3.P>LBL 268 ;distributor  
DE 3.P>SMO ;distributor  
DE 4.P>C 4679 ;distributor  
DE 4.P>F5898 ;distributor  
DE 4.P>P9312 ;distributor  
DE 4.P>R6395 ;distributor  
DE 4.P>SMO ;distributor  
DO G>Mus musculus CN>mouse  
PD ;IgM  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36  
RE 1.a.CC>differentiation  
AV ;purified ;2.purified ;4.fluorescein conjugate  
AV ;4.phycoerythrin conjugate  
SD C4679  
SD F5898  
SD LBL268  
SD MCA722  
SD MCA722F  
SD P54168M  
SD P9312  
SD R6395  
SD SMO  
SD SMO  
LD USA BAL  
EI DA>9803 CV>9111  
CI ;catalog  
SN Synonym>CD36 1012380 SN Synonym>CD36

- 61 -

**1003558 RE 1.CE>platelet 1.U>cell membrane 1.SN>CD36**

1003558 RE 1.CE&gt;platelet 1.U&gt;cell membrane 1.SN&gt;CD36

AN 1003558

DI P&gt;Biodesign International

DI 105 York Street

DI Kennebunkport, ME 04043 USA

DI 1-207-985-1944

DE P&gt;N42540M ;distributor

PD ;IgG1

RE 1.CE&gt;platelet 1.U&gt;cell membrane 1.SN&gt;CD36

RE 1.a.CC&gt;differentiation 1.b.CC&gt;protein

RE 1.c.CC&gt;blood coagulation factor

AV ;purified

SD N42540M

LD USA BAL

EI DA&gt;9002 CV&gt;9007

CI ;catalog

SN Synonym&gt;CD36 1003558 SN Synonym&gt;CD36

- 62 -

**1024459 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36**

1024459 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

DI P&gt;Biogenesis Ltd.

DI 7 New Fields

DI Stinsford Road

DI Poole BH17 7NF, England

DI UK

DI 44-1202 660006

DE C&gt;SM-phi IgM ;distributor

DE P&gt;2125-3607 ;distributor

DO G&gt;Mus musculus CN&gt;mouse

PD ;Ig

RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

RE 1.a.CC&gt;differentiation

AP ;immunofluorescence

AV ;fluorescein conjugate

AB CD36 is also known as platelet GPIV, GPIV, platelet GPIIIb,  
GPIIIb, platelet

AB glycoprotein IV, and FAT (rat).

SD 21253607

SD SMPHIIGM

LD USA MCM

EI DA&gt;9811

CI ;catalog

SN.Synonym&gt;CD36 1024459 SN.Synonym&gt;CD36

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**1016854 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet**

1016854 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.CE&gt;platelet

AN 1016854

DI P&gt;PharMingen

DI 10975 Torreyana Road

DI San Diego, CA 92121 USA

DI 1-619-677-7737

DI 1-800-848-6227 (toll free USA)

DE P&gt;CB38 ;distributor

DO G&gt;Mus musculus CN&gt;mouse S&gt;BALB/c

PD ;IgM ;kappa

RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.CE&gt;platelet

RE 1.U&gt;cell membrane 1.SN&gt;CD36 1.MW&gt;88 kD

RE 1.a.CC&gt;differentiation 1.b.CC&gt;glycoprotein

AP ;flow cytometry ;immunoprecipitation

AV ;fluorescein conjugate ;purified

SD CB38

LD USA JMJ

EI DA&gt;9504

CI ;catalog

SN Synonym&gt;CD36 1016854 SN Synonym&gt;CD36

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**1012440 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36**

1012440 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD36

AN 1012440  
DI P>BioSource International  
DI 820 Flynn Roa  
DI Camarillo, CA 93012 USA  
DI 1-800-242-0607(toll free USA)  
DI 1-805-987-0086  
DI 2.P>Cymbus Bioscience Limited  
DI 2 Venture Road  
DI Chilworth Research Center  
DI Southampton, Hampshire SO1 7NS UK  
DI 44-703-767178  
DI 3.P>Roche Molecular Biochemicals  
DI formerly Boehringer Mannheim GmbH  
DI Sandhofer Strasse 116  
DI D-68305 Mannheim Germany  
DI 49-621-759 8577  
DE C>SMO ;developer  
DE P>AHS3601 ;distributor  
DE P>AHS3608 ;distributor  
DE P>CS-CD36-FI ;discontinued designation  
DE P>CS-CD36-UN ;discontinued designation  
DE P>SMO ;distributor  
DE 2.P>CBL 168 ;distributor  
DE 2.P>SMO ;distributor  
DE 3.P>1441 230 ;discontinued designation  
DE 3.P>1441 264 ;distributor  
DE 3.P>SMO ;distributor  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36  
RE 1.a.CC>differentiation  
AV ;fluorescein conjugate ;3.purified  
SD 1441230  
SD 1441264  
SD AHS3601  
SD AHS3608  
SD CBL168  
SD CSCD36FI  
SD CSCD36UN  
SD SMO  
LD USA BAL  
EI DA>9709 CV>9111  
CI ;catalog  
SN Synonym>CD36 1012440 SN Synonym>CD36

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**1003358 RE 1.SN>ACTH 1.FS>N-terminal region 1.a.CC>ho**

1003358 RE 1.SN&gt;ACTH 1.FS&gt;N-terminal region 1.a.CC&gt;hormone

AN 1003358  
DI P>Biodesign International  
DI 105 York Street  
DI Kennebunkport, ME 04043 USA  
DI 1-207-985-1944  
DI 2.P>Cymbus Bioscience Limited  
DI 2 Venture Road  
DI Chilworth Research Center  
DI Southampton, Hampshire SO1 7NS UK  
DI 44-703-767178  
DE C>58 ;developer  
DE P>E54008M ;distributor  
RE 1.SN>ACTH 1.FS>N-terminal region 1.a.CC>hormone  
AV ;purified  
AB CD36 is also known as GPIIIb, GPIV  
SD 58  
SD E54008M  
LD USA BAL  
EI DA>9002 CV>9007  
CI ;catalog  
SN Synonym>ACTH

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1019119 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36 1.MW

1019119 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36 1.MW>88 kD

AN 1019119

SO J Cell Biol 1994;269:6011

SO J Cell Biol 1993;268:16179

DI P>Transduction Laboratories

DI 133 Venture Ct., Suite 5

DI Lexington, Ky 40511-9923

DI 1-606-259-1550

DI 1-800-227-4063

DE P>73 ;distributor

DE P>C23620 ;distributor

IM G>Homo sapiens CN>human SN>CD36 FS>amino acids 70-242

IM a.CC>protein

DO G>Mus musculus CN>mouse

PD ;IgG2a

RE 1.G>Homo sapiens 1.CN>human 1.SN>CD36 1.MW>88 kD

RE 1.a.CC>protein

RE 2.G>Rattus norvegicus 2.CN>Norway rat 2.SN>CD36

RE 2.MW>88 kD 2.a.CC>protein

RE 3.G>Gallus gallus 3.CN>chicken 3.SN>CD36 3.MW>88 kD

RE 3.a.CC>protein

AP ;Western blot ;immunofluorescence

AV ;purified

SD 73

SD C23620

LD USA JMJ

EI DA>9901

CI ;catalog

SN Synonym>CD36 1019119 SN Synonym>CD36

APPENDIX 2

DI is distributor  
SD is standard designation



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**1022961 RE 1.SN>CD51 1.a.CC>differentiation**

1022961 RE 1.SN&gt;CD51 1.a.CC&gt;differentiation

AN 1022961  
DI P>Caltag Laboratories  
DI 1849 Bayshore Blvd. #200  
DI Burlingame, CA 94010  
DI 1-650-652-0468  
DI 1-800-874-4007  
DE C>NGX-IV/110 ;distributor  
DE P>MON1027 ;distributor  
RE 1.SN>CD51 1.a.CC>differentiation

SD NGXIV110  
LD USA MCM  
EI DA>9805  
CI ;catalog

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**1022017 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51/61 c**

1022017 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD51/61 c

AN 1022017

DI P&gt;O.E.M. Concepts, Inc

DI 1889 Route 9, Bldg. 25, Unit 96

DI Toms River, NJ 08755 USA

DI 1-732-341-3570

DE C&gt;289-12336 ;distributor

DE P&gt;M2-L69 ;distributor

DO G&gt;Mus musculus CN&gt;mouse

RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD51/61 complex

RE 1.a.CC&gt;differentiation

AP ;cell surface marker

AV ;purified

AB Reactant#1: CD51/61 complex is also known as integrin alpha V  
beta 3.

SD 28912336

SD M2L69

LD USA EJK

EI DA&gt;9712

CI ;catalog

SN Synonym&gt;CD51/61 complex 1022018 \*\*\*\*\*HB/HYBRID

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**1013413 RE 1.CE>platelet 1.SN>CD51 1.a.CC>differentiation**

1013413 RE 1.CE&gt;platelet 1.SN&gt;CD51 1.a.CC&gt;differentiation

AN 1013413  
DI P>Medica  
DI 2382 Camino Vida Roble, Suite I  
DI Carlsbad, CA 92009 USA  
DI 1-619-438-1886  
DE C>706 ;developer  
DE P>MON1130 ;distributor  
PD ;IgG1  
RE 1.CE>platelet 1.SN>CD51 1.a.CC>differentiation  
  
SD MON1130  
LD USA BAL  
EI DA>9303  
CI ;catalog

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**1024461 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51**

1024461 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD51

AN 1024461  
DI P>Biogenesis Ltd.  
DI 7 New Fields  
DI Stinsford Road  
DI Poole BH17 7NF, England  
DI UK .  
DI 44-1202 660006  
DE C>13C2 ;distributor  
DE P>2125-5108 ;distributor  
DE P>2125-5114 ;distributor  
DE P>2125-5119 ;distributor  
DO G>Mus musculus CN>mouse  
PD ;Ig  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51  
RE 1.a.CC>differentiation  
AP ;immunofluorescence  
AV ;R-phycoerythrin conjugate ;fluorescein conjugate  
AB CD51 is also known as integrin alpha V subunit and vitronectin  
receptor  
AB alpha subunit.  
SD 13C2  
SD 21255108  
SD 21255114  
SD 21255119  
LD USA MCM  
EI DA>9811  
CI ;catalog

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**1017037 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51**

1017037 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD51

DI P>Zymed Laboratories Inc.  
DI 458 Carlton Court  
DI South San Francisco, CA 94080 USA  
DI 1-800-874-4494 (toll free USA)  
DI 1-415-871-4494  
DE P>07-5103 ;distributor  
DE P>NK1-M9 ;distributor  
DO G>Mus musculus CN>mouse S>BALB/c  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51  
RE 1.a.CC>differentiation 1.b.CC>protein  
AP ;flow cytometry ;immunofluorescence  
AV ;purified  
SD 075103  
SD NK1M9  
LD USA JMJ  
EI DA>9708  
CI ;catalog

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**1009962 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51**

1009962 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD51

AN 1009962  
DI P>Biodesign International  
DI 105 York Street  
DI Kennebunkport, ME 04043 USA  
DI 1-207-985-1944  
DI 2.P>Harlan Bioproducts for Science, Inc.  
DI P.O. Box 29176  
DI Indianapolis, IN 46229-0176  
DI 1-317-894-7536  
DI 1-800-9-SCIENCE  
DE C>AMF7 ;developer  
DE P>AMF7 ;distributor  
DE P>P42770M ;distributor  
DE 2.P>MCA 683 ;distributor  
DO G>Mus musculus CN>mouse  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51  
RE 1.a.CC>differentiation  
AV ;purified ;2.purified  
SD AMF7  
SD MCA683  
SD P42770M  
LD USA BAL  
EI DA>9103 CV>9104  
CI ;catalog

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**1021411 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet**

1021411 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.CE&gt;platelet 1.SN&gt;CD51

AN 1021411  
DI P>Immunotech S.A.  
DI Departement commercial  
DI Luminy Case 915  
DI 13288 Marseille Cedex 9, France  
DI 33-91-41-41-38  
DI 430246 F IMMTECH  
DE C>69-6-5 ;distributor  
DE P>1603 ;distributor  
DO G>Mus musculus CN>mouse S>BALB/c O>spleen  
PD ;IgG2a  
RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD51  
RE 1.a.CC>protein  
AV ;purified  
SD 1603  
SD 6965  
LD USA JMJ  
EI DA>9707  
CI ;catalog

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**1015384 RE 1.G>Mus musculus 1.CN>mouse 1.SN>CD51**

1015384 RE 1.G&gt;Mus musculus 1.CN&gt;mouse 1.SN&gt;CD51

AN 1015384  
DI P>PharMingen  
DI 10975 Torreyana Road  
DI San Diego, CA 92121 USA  
DI 1-619-677-7737  
DI 1-800-848-6227 (toll free USA)  
DE C>H9.2B8 ;developer  
DE P>01520D ;distributor  
DE P>01521D ;distributor  
DE P>01522D ;distributor  
DE P>01525B ;distributor  
DO G>Cricetulus sp. CN>hamster  
IP G>Mus musculus CN>mouse  
PD ;IgG  
RE 1.G>Mus musculus 1.CN>mouse 1.SN>CD51  
RE 1.a.CC>differentiation  
AP ;flow cytometry ;immunofluorescence  
AV ;biotin conjugate ;fluorescein conjugate  
AV ;phycoerythrin conjugate ;purified  
SD 01520D  
SD 01521D  
SD 01522D  
SD 01524D  
SD 01525B  
SD H92B8  
LD USA BAL  
EI DA>9408  
CI ;catalog



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**1023962 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51**

1023962 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD51

AN 1023962  
SO Cell 1992;69:11-25  
DI P>Ansell Corporation  
DI 243 Third Street North  
DI P.O. Box 87  
DI Bayport, MN 55003 USA  
DI 1-800-374-9523 (toll free USA)  
DI 1-612-439-0835  
DE C>P2W7 ;distributor  
DE P>202-020 ;distributor  
DE P>202-030 ;distributor  
DE P>202-040 ;distributor  
DE P>202-050 ;distributor  
IM G>Homo sapiens CN>human O>eye PA>melanoma CD>V+B2 a.CC>neoplasm  
DO G>Mus musculus CN>mouse  
PD ;IgG1 ;kappa  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51  
RE 1.a.CC>differentiation  
AP ;immunoprecipitation ;flow cytometry ;frozen section  
AV ;R-phycoerythrin conjugate ;biotin conjugate  
AV ;fluorescein conjugate ;purified  
SD 202020  
SD 202030  
SD 202040  
SD 202050  
SD P2W7  
LD USA MCM  
EI DA>9808  
CI ;catalog

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**1023559 RE 1.G>Mus musculus 1.CN>mouse 1.SN>integrin**

1023559 RE 1.G&gt;Mus musculus 1.CN&gt;mouse 1.SN&gt;integrin alpha V

SO Biochemistry 1990;29:10191  
SO Exp Cell Res 1993;205:25  
DI P>Upstate Biotechnology, Inc.  
DI 199 Saranac Avenue  
DI Lake Placid, NY 12946 USA  
DI 1-617-890-8845  
DI 1-800-233-3991 (toll free USA) (sales)  
DE P>05-437 ;distributor  
DO G>Mus musculus CN>mouse  
RE 1.G>Mus musculus 1.CN>mouse 1.SN>integrin alpha V  
RE 1.MW>160 kD 1.a.CC>differentiation 1.b.CC>receptor  
AP ;Western blot ;immunoprecipitation ;immunohistochemistry  
AV ;ascites  
AB Reactant is also known as vitronectin receptor alpha subunit and  
CD51.  
SD 05437  
LD USA MCM  
EI DA>9807  
CI ;catalog

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**1023927 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin**

1023927 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;integrin alpha V

AN 1023927

SO J Biol Chem 1994;269:6940

DI P&gt;Chemicon International, Inc.

DI 28835 Single Oak Dr.

DI Temecula, CA 92590 USA

DI 1-909-676-8080

DI 1-800-437-7500(toll free USA)

DE C&gt;P3G8 ;distributor

DE P&gt;MAB1953 ;distributor

IM G&gt;Homo sapiens CN&gt;human O&gt;lung PA&gt;carcinoma a.CC&gt;neoplasm

DO G&gt;Mus musculus CN&gt;mouse

PD ;IgG1

RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;integrin alpha V

RE 1.a.CC&gt;differentiation 1.b.CC&gt;receptor

AP ;immunocytology ;immunohistochemistry ;immunoprecipitation

AP ;flow cytometry ;ELISA ;FACS

AV ;purified

AB Reactant is also known as CD51 and vitronectin receptor alpha subunit.

AB Product reacts with all alpha V-containing integrin receptors.

AB Product will react with some lymphoid cell lines (B cells), many carcinoma and

AB melanoma cell lines and osteosarcomas.

SD MAB1953

SD P3G8

LD USA MCM

EI DA&gt;9808

CI ;catalog

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**1015432 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51 1.FS**

1015432 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;CD51 1.FS&gt;alpha subunit

AN 1015432  
DI P>Biodesign International  
DI 105 York Street  
DI Kennebunkport, ME 04043 USA  
DI 1-207-985-1944  
DI 2.P>Caltag Laboratories  
DI 1849 Bayshore Blvd. #200  
DI Burlingame, CA 94010  
DI 1-650-652-0468  
DI 1-800-874-4007  
DI 3.P>Cymbus Bioscience Limited  
DI 2 Venture Road  
DI Chilworth Research Center  
DI Southampton, Hampshire SO1 7NS UK  
DI 44-703-767178  
DI 4.P>Endogen Inc.  
DI 30 Commerce Way  
DI Woburn, MA 01801-1059 USA  
DI 1-781-937-0890  
DI 5.P>Genosys Biotechnologies, Inc.  
DI 1442 Lake Front Circle, Suite 185  
DI The Woodlands, TX 77380-3600 USA  
DI 1-713-363-3693  
DI 1-800-234-5362 (toll free USA)  
DI 6.P>Harlan Bioproducts for Science, Inc.  
DI P.O. Box 29176  
DI Indianapolis, IN 46229-0176  
DI 1-317-894-7536  
DI 1-800-9-SCIENCE  
DI 7.P>Lampire Biological Laboratories  
DI P.O. Box 270  
DI Pipersville, PA 18947 USA  
DI 1-215-795-2838  
DI 8.P>PharMingen  
DI 10975 Torreyana Road  
DI San Diego, CA 92121 USA  
DI 1-619-677-7737  
DI 1-800-848-6227 (toll free USA)  
DI 9.P>T Cell Diagnostics, Inc.  
DI 6 Gill Street  
DI Woburn, MA 01801-1721 USA  
DI 1-800-624-4021  
DI 1-617-937-9587  
DE C>23C6 ;developer  
DE P>23C6 ;distributor  
DE P>P54490M ;distributor  
DE 2.P>23C6 ;distributor  
DE 2.P>MON1167 ;distributor  
DE 3.P>23C6 ;distributor  
DE 3.P>CBL490 ;distributor  
DE 4.P>23C6 ;distributor  
DE 4.P>MA-5100 ;distributor  
DE 5.P>23C6 ;distributor  
DE 5.P>AM-19-760 ;distributor  
DE 6.P>23C6 ;distributor  
DE 6.P>MCA-757 ;discontinued designation

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DE 6.P>MCA757G ;distributor  
DE 7.P>23C6 ;distributor  
DE 7.P>LBL 590 ;distributor  
DE 8.P>23C6 ;distributor  
DE 8.P>31561A ;distributor  
DE 8.P>31564X ;distributor  
DE 9.P>23C6 ;distributor  
DE 9.P>IA1S04 ;distributor  
DO G>Mus musculus CN>mouse  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD51 1.FS>alpha subunit  
RE 1.MW>125 kD 1.a.CC>differentiation  
AV ;purified ;4.purified ;6.purified ;8.fluorescein conjugate  
AV ;8.purified ;9.supernatant  
SD 23C6  
SD 31561A  
SD 31564X  
SD AM19760  
SD CBL490  
SD IA1S04  
SD LBL590  
SD MA5100  
SD MCA757  
SD MCA757G  
SD MON1167  
SD P54490M  
LD USA BAL  
EI DA>9706  
CI ;catalog

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**1011348 RE 1.G>Homo sapiens 1.CN>human 1.SN>vitronect**

1011348 RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;vitronectin receptor

AN 1011348

DI P&gt;Chemicon International, Inc.

DI 28835 Single Oak Dr.

DI Temecula, CA 92590 USA

DI 1-909-676-8080

DI 1-800-437-7500(toll free USA)

DE P&gt;CLB-706 ;distributor

DE P&gt;MAB1980 ;distributor

RE 1.G&gt;Homo sapiens 1.CN&gt;human 1.SN&gt;vitronectin receptor

RE 1.a.CC&gt;receptor

AV ;purified

AB beta subunit of vitronectin receptor referred to as CD51 also

AB Reactant#1: vitronectin receptor beta subunit syn. for CD51

SD CLB706

SD MAB1980

LD USA BAL

EI DA&gt;9107 CV&gt;9108

CI ;catalog

SN Synonym&gt;vitronectin receptor

APPENDIX 3

DI is distributor  
SD is standard designation

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Beta 5

1019741 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 5  
AN 1019741  
DI P>Upstate Biotechnology, Inc.  
DI 199 Saranac Avenue  
DI Lake Placid, NY 12946 USA  
DI 1-617-890-8845  
DI 1-800-233-3991 (toll free USA) (sales)  
DE C>B5-IVF2 ;distributor  
DE P>05-283 ;distributor  
DO G>Mus musculus CN>mouse S>BALB/c O>spleen  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 5  
RE 1.a.CC>protein  
AP ;immunocytochemistry ;blocks cell adhesion  
AV ;ascites  
SD 05283  
SD B5IVF2  
LD USA JMJ  
EI DA>9611  
CI ;catalog



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Beta 3

1011332 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
AN 1011332  
DI P>Chemicon International, Inc.  
DI 28835 Single Oak Dr.  
DI Temecula, CA 92590 USA  
DI 1-909-676-8080  
DI 1-800-437-7500(toll free USA)  
DE P>MAB1974 ;distributor  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
RE 1.a.CC>receptor  
AV ;ascites  
SD MAB1974  
LD USA BAL  
EI DA>9107 CV>9108  
CI ;catalog

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1014236 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
AN 1014236  
AU Ylanne J  
SO Blood 1989;72:1478-86  
SO Blood 1990;76:570-7  
DI P>Biohit OY  
DI Verkkosaarenkatu 4  
DI 00580 Helsinki, Finland  
DI 358-0-773-2900  
DI 2.P>Harlan Bioproducts for Science, Inc.  
DI P.O. Box 29176  
DI Indianapolis, IN 46229-0176  
DI 1-317-894-7536  
DI 1-800-9-SCIENCE  
DI 3.P>ICN Biomedicals  
DI Biomedical Research Products  
DI 3300 Hyland Avenue  
DI Costa Mesa, CA 92626  
DI 1-800-854-0530 (toll free USA)  
DI 1-714-545-0100  
DI 4.P>Locus Genex Oy  
DI Verkkosaarenkatu 4  
DI 00580 Helsinki, Finland  
DI 358-9-773-861  
DE C>BB10 ;developer  
DE P>M-9006000 ;distributor  
DE P>M-9006100 ;distributor  
DE 2.P>MCA-781 ;distributor  
DE 2.P>bb10 ;distributor  
DE 3.P>69-323-1 ;distributor  
DE 3.P>69-323-2 ;distributor  
DE 3.P>BB10 ;distributor  
DE 4.P>BB10 ;distributor  
DE 4.P>M-9006000 ;distributor  
DE 4.P>M-9006100 ;distributor  
IM G>Homo sapiens CN>human SN>CD41 ;purified a.CC>differentiation  
RM ;in vivo  
DO G>Mus musculus CN>mouse S>BALB/c O>spleen  
IP G>Mus musculus CN>mouse PA>myeloma  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
RE 1.a.CC>receptor  
RE 2.G>Homo sapiens 2.CN>human 2.SN>platelet GPIIIa  
RE 2.a.CC>blood coagulation factor  
AP ;immunoassay ;not paraffin section ;immunohistochemical staining  
AP ;immunoblotting  
AV ;purified ;2.purified ;3.purified ;4.purified  
SD 693231  
SD 693232  
SD BB10  
SD M9006000  
SD M9006100  
SD MCA781  
LD USA BAL

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EI DA>9711

SN Synonym>CD41 1014236 SN Synonym>CD41

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1014281 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
AN 1014281  
DI P>Bio-Science Products AG  
DI Gerliswilstrasse 43  
DI Postfach 1173  
DI CH-6020 Emmenbrucke, Switzerland  
DI 41-555875  
DE P>0121022 ;distributor  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
RE 1.a.CC>receptor  
RE 2.G>Homo sapiens 2.CN>human 2.SN>CD41  
RE 2.a.CC>differentiation  
AP ;immunoassay ;immunoblotting ;not paraffin section  
AP ;immunohistochemical staining  
LD USA BAL  
EI DA>9305  
CI ;catalog  
SN Synonym>CD41 1014281 SN Synonym>CD41

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1019109 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
AN 1019109  
SO J Cell Biol 1993;122:223  
SO J Cell Biol 1993;121:689  
DI P>Transduction Laboratories  
DI 133 Venture Ct., Suite 5  
DI Lexington, Ky 40511-9923  
DI 1-606-259-1550  
DI 1-800-227-4063  
DE P>26 ;distributor  
DE P>I19620 ;distributor  
IM G>Mus musculus CN>mouse SN>integrin beta 3 FS>amino acids 16-223  
IM a.CC>protein  
DO G>Mus musculus CN>mouse  
PD ;IgM  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
RE 1.MW>90 kD 1.a.CC>protein  
RE 2.G>Canis familiaris 2.CN>dog 2.SN>integrin beta 3  
RE 2.MW>90 kD 2.a.CC>protein  
RE 3.G>Rattus norvegicus 3.CN>Norway rat 3.SN>integrin beta 3  
RE 3.MW>90 kD 3.a.CC>protein  
RE 4.G>Mus musculus 4.CN>mouse 4.SN>integrin beta 3  
RE 4.MW>90 kD 4.a.CC>protein  
RE 5.G>Gallus gallus 5.CN>chicken 5.SN>integrin beta 3  
RE 5.MW>90 kD 5.a.CC>protein  
AP ;Western blot  
AV ;purified  
SD 26  
SD I19620  
LD USA JMJ  
EI DA>9705  
CI ;catalog

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1023930 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
AN 1023930  
SO Cell 1986;45:269-80  
DI P>Chemicon International, Inc.  
DI 28835 Single Oak Dr.  
DI Temecula, CA 92590 USA  
DI 1-909-676-8080  
DI 1-800-437-7500(toll free USA)  
DE C>25E11 ;distributor  
DE P>MAB1957 ;distributor  
IM T>blood CE>mononuclear cell CS>activated  
DO G>Mus musculus CN>mouse  
PD ;IgG2a  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin beta 3  
RE 1.a.CC>differentiation 1.b.CC>receptor  
RE 2.SN>CD41/CD61 complex 2.a.CC>protein  
RE 3.G>Homo sapiens 3.CN>human 3.CE>monoblast 3.PA>leukemia  
RE 3.CD>U937 3.SN>CD41/CD61 complex 3.a.CC>protein  
AP ;Western blot ;immunocytology ;immunoprecipitation  
AP ;flow cytometry  
AV ;purified a.PM>protein A chromatography  
AB Integrin beta 3 is also known as CD61, GPIIIa, and vitronectin  
AB receptor beta chain.  
SD 25E11  
SD MAB1957  
LD USA MCM  
EI DA>9808  
CI ;catalog

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1024059 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
AN 1024059  
DI P>PharMingen  
DI 10975 Torreyana Road  
DI San Diego, CA 92121 USA  
DI 1-619-677-7737  
DI 1-800-848-6227 (toll free USA)  
DE C>VI-PL2 ;distributor  
DE P>33821 ;distributor  
DE P>33824 ;distributor  
DE P>33825 ;distributor  
DO G>Mus musculus CN>mouse  
PD ;IgG1 ;kappa  
RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
RE 1.MW>105 kD 1.a.CC>differentiation 1.b.CC>glycoprotein  
RE 2.G>Homo sapiens 2.CN>human 2.CE>megakaryocyte 2.SN>CD61  
RE 2.MW>105 kD 2.a.CC>differentiation 2.b.CC>glycoprotein  
RE 3.G>Homo sapiens 3.CN>human 3.CE>osteoclast 3.SN>CD61  
RE 3.MW>105 kD 3.a.CC>differentiation 3.b.CC>glycoprotein  
RE 4.G>Homo sapiens 4.CN>human 4.T>endothelium 4.SN>CD61  
RE 4.MW>105 kD 4.a.CC>differentiation 4.b.CC>glycoprotein  
XR 1.G>Canis sp. 1.CN>dog 1.SN>CD61 1.a.CC>differentiation  
XR 1.b.CC>glycoprotein  
XR 2.G>Felis sp. 2.CN>cat 2.SN>CD61 2.a.CC>differentiation  
XR 2.b.CC>glycoprotein  
NR 1.G>Sus sp. 1.CN>swine 1.SN>CD61 1.a.CC>differentiation  
NR 1.b.CC>glycoprotein  
AP ;acetone fixed ;frozen section  
AV ;R-phycoerythrin conjugate ;biotin conjugate  
AV ;fluorescein conjugate ;purified  
AB CD61 is also known as integrin beta 3 subunit.  
SD 33821  
SD 33824  
SD 33825  
SD VIPL2  
LD USA MCM  
EI DA>9809  
CI ;catalog

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1011347 RE 1.G>Homo sapiens 1.CN>human 1.SN>vitronectin receptor  
AN 1011347  
DI P>Chemicon International, Inc.  
DI 28835 Single Oak Dr.  
DI Temecula, CA 92590 USA  
DI 1-909-676-8080  
DI 1-800-437-7500(toll free USA)  
DE P>MAB1984 ;distributor  
RE 1.G>Homo sapiens 1.CN>human 1.SN>vitronectin receptor  
RE 1.a.CC>receptor  
AB Reactant#1 vitronectin receptor alpha subunit syn. for CD61  
SD MAB1984  
LD USA BAL  
EI DA>9107 CV>9108  
CI ;catalog  
SN Synonym>vitronectin receptor



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1012445 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD61  
AN 1012445  
DI P>Cymbus Bioscience Limited  
DI 2 Venture Road  
DI Chilworth Research Center  
DI Southampton, Hampshire SO1 7NS UK  
DI 44-703-767178  
DE C>Thromb/1 ;developer  
DE P>CBL 458 ;discontinued designation  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD61  
RE 1.a.CC>differentiation  
SD THROMB1  
LD USA BAL  
EI DA>9110 CV>9111  
CI ;catalog

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1013416 RE 1.CE>platelet 1.SN>CD61 1.a.CC>differentiation  
AN 1013416  
DI P>Caltag Laboratories  
DI 1849 Bayshore Blvd. #200  
DI Burlingame, CA 94010  
DI 1-650-652-0468  
DI 1-800-874-4007  
DI 2.P>Medica  
DI 2382 Camino Vida Roble, Suite I  
DI Carlsbad, CA 92009 USA  
DI 1-619-438-1886  
DI 3.P>Sigma Chemical Company  
DI P.O. Box 14508  
DI St. Louis, MO 63178 9916 USA  
DI 1-800-325-3010 (toll free USA)  
DI 1-314-771-5750  
DE C>BL-E6 ;developer  
DE P>BL-E6 ;distributor  
DE P>MHCD6101 ;distributor  
DE P>MHCD6101-4 ;distributor  
DE P>MHCD6115 ;distributor  
DE P>MHCD6115-4 ;distributor  
DE P>MON1051 ;distributor  
DE 2.P>MON1051 ;distributor  
DE 3.P>BL-E6 ;distributor  
DE 3.P>C4321 ;distributor  
DE 3.P>F7902 ;distributor  
DO G>Mus musculus CN>mouse  
PD ;IgG1  
RE 1.CE>platelet 1.SN>CD61 1.a.CC>differentiation  
RE 2.CE>megakaryocyte 2.SN>CD61 2.a.CC>differentiation  
AP ;frozen section  
AV ;biotin conjugate ;fluorescein conjugate  
AV ;3.fluorescein conjugate  
SD BLE6  
SD C4321  
SD F7902  
SD MHCD6101  
SD MHCD61014  
SD MHCD6115  
SD MHCD61154  
SD MON1051  
LD USA BAL  
EI DA>9803  
CI ;catalog

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1013417 RE 1.CE>platelet 1.SN>CD61 1.a.CC>differentiation  
AN 1013417  
DI P>Caltag Laboratories  
DI 1849 Bayshore Blvd. #200  
DI Burlingame, CA 94010  
DI 1-650-652-0468  
DI 1-800-874-4007  
DI 2.P>Medica  
DI 2382 Camino Vida Roble, Suite I  
DI Carlsbad, CA 92009 USA  
DI 1-619-438-1886  
DE C>CRC54 ;developer  
DE P>CRC54 ;distributor  
DE P>MON1147 ;distributor  
DE 2.P>MON1147 ;distributor  
PD ;IgG1  
RE 1.CE>platelet 1.SN>CD61 1.a.CC>differentiation  
RE 2.CE>megakaryocyte 2.SN>CD61 2.a.CC>differentiation  
AP ;frozen section  
SD MON1147  
LD USA BAL  
EI DA>9303  
CI ;catalog

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1014017 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD61  
DI P>Diagast Laboratories  
DI 59, rue de Trevisse-B.P. 2034  
DI 59014 Lille Cedex, France  
DI 33-20-52-68-00  
DI DIAGAST (042) 160716F  
DE P>16101V ;distributor  
DE P>16103A ;distributor  
DE P>16105E ;distributor  
PD ;IgG  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD61  
RE 1.a.CC>differentiation  
AV ;fluorescein conjugate ;phycoerythrin conjugate ;purified  
SD 16101V  
SD 16103A  
SD 16105E  
LD USA BAL  
EI DA>9304  
CI ;catalog

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1014618 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
AN 1014618  
DI P>BioSource International  
DI 820 Flynn Roa  
DI Camarillo, CA 93012 USA  
DI 1-800-242-0607 (toll free USA)  
DI 1-805-987-0086  
DI 2.P>Cymbus Bioscience Limited  
DI 2 Venture Road  
DI Chilworth Research Center  
DI Southampton, Hampshire SO1 7NS UK  
DI 44-703-767178  
DI 3.P>Endogen Inc.  
DI 30 Commerce Way  
DI Woburn, MA 01801-1059 USA  
DI 1-781-937-0890  
DI 4.P>Genosys Biotechnologies, Inc.  
DI 1442 Lake Front Circle, Suite 185  
DI The Woodlands, TX 77380-3600 USA  
DI 1-713-363-3693  
DI 1-800-234-5362 (toll free USA)  
DI 5.P>Harlan Bioproducts for Science, Inc.  
DI P.O. Box 29176  
DI Indianapolis, IN 46229-0176  
DI 1-317-894-7536  
DI 1-800-9-SCIENCE  
DI 6.P>Lampire Biological Laboratories  
DI P.O. Box 270  
DI Pipersville, PA 18947 USA  
DI 1-215-795-2838  
DI 7.P>Novocastra Laboratories Ltd.  
DI 24 Claremont Place  
DI Newcastle upon Tyne NE2 4AA, UK  
DI 44-0191 222 8550  
DI 8.P>Southern Biotechnology Associates, Inc.  
DI P.O. Box 26221  
DI Birmingham, AL 35260 USA  
DI 1-800-722-2255 (toll free USA)  
DI 1-205-945-1774  
DI 9.P>T Cell Diagnostics, Inc.  
DI 6 Gill Street  
DI Woburn, MA 01801-1721 USA  
DI 1-800-624-4021  
DI 1-617-937-9587  
DE C>PM 6/13 ;developer  
DE P>AHS6101 ;distributor

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DE P>AHS6107 ;distributor  
DE P>AHS6108 ;distributor  
DE P>CS-CD61-CF ;discontinued designation  
DE P>CS-CD61-FI ;discontinued designation  
DE P>CS-CD61-PE ;discontinued designation  
DE 2.P>CBL479 ;distributor  
DE 2.P>PM6/13 ;distributor  
DE 3.P>MA-6100 ;distributor  
DE 3.P>PM6/13 ;distributor  
DE 4.P>AM-19-705 ;distributor  
DE 4.P>PM6/13 ;distributor  
DE 5.P>MCA-728 ;distributor  
DE 5.P>MCA-728F ;distributor  
DE 5.P>MCA-728PE ;distributor  
DE 5.P>PM6/13 ;distributor  
DE 6.P>LBL 579 ;distributor  
DE 6.P>PM6/13 ;distributor  
DE 7.P>NCL-CD61 ;distributor  
DE 7.P>PM6/13 ;distributor  
DE 8.P>9470-01 ;distributor  
DE 8.P>9470-02 ;distributor  
DE 8.P>9470-08 ;distributor  
DE 8.P>PM6/13 ;distributor  
DE 9.P>IA1S09 ;distributor  
DE 9.P>PM6/13 ;distributor  
DO G>Mus musculus CN>mouse  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
RE 1.MW>90 kD 1.a.CC>differentiation  
RE 2.G>Homo sapiens 2.CN>human 2.T>plasma 2.SN>CD61  
RE 2.MW>90 kD 2.a.CC>differentiation  
RE 3.G>Homo sapiens 3.CN>human 3.T>plasma  
RE 3.PA>unspecified neoplasm 3.SN>CD61 3.MW>90 kD  
RE 3.a.CC>neoplasm 3.b.CC>differentiation  
AV ;fluorescein conjugate ;phycoerythrin conjugate ;purified  
AV ;3.purified ;5.fluorescein conjugate  
AV ;5.phycoerythrin conjugate ;5.purified ;8.biotin conjugate  
AV ;8.fluorescein conjugate ;8.purified ;9.purified  
SD 947001  
SD 947002  
SD 947008  
SD AHS6101  
SD AHS6107  
SD AHS6108  
SD AM19705  
SD CBL479  
SD CSCD61CF

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SD CSCD61FI  
SD CSCD61PE  
SD IA1S09  
SD LBL579  
SD MA6100  
SD MCA728  
SD MCA728F  
SD MCA728PE  
SD NCLCD61  
SD PM613  
LD USA BAL  
EI DA>9904  
CI ;catalog

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1017042 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
AN 1017042  
DI P>Becton Dickinson Immunocytometry Systems  
DI 2350 Qume Drive  
DI San Jose, CA 95131-1807  
DI 1-800-223-8226 (toll free USA)  
DI 1-408-954-2347  
DE P>348090 ;distributor  
DE P>348093 ;distributor  
DE P>559936 ;distributor  
DE P>RUU-PL7F12 ;distributor  
DO G>Mus musculus CN>mouse S>BALB/c  
PD ;IgG1 ;kappa  
RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
RE 1.a.CC>differentiation 1.b.CC>protein  
AP ;immunofluorescence ;immunoprecipitation  
AV ;fluorescein conjugate ;purified  
SD 348090  
SD 348093  
SD 559936  
SD RUUPL7F12  
LD USA JMJ  
EI DA>9505  
CI ;catalog



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1017635 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD61  
AN 1017635  
DI P>Novocastra Laboratories Ltd.  
DI 24 Claremont Place  
DI Newcastle upon Tyne NE2 4AA, UK  
DI 44-0191 222 8550  
DE P>NCL-CD61 ;distributor  
DE P>PM6/13 ;distributor  
DO G>Mus musculus CN>mouse  
AS ;immunohistochemical staining  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD61  
RE 1.a.CC>differentiation  
AP ;frozen section  
AV ;ascites  
SD NCLCD61  
SD PM613  
LD USA BAL  
EI DA>9904  
CI ;catalog

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1019745 RE 1.G>Homo sapiens 1.CN>human 1.SN>CD61  
AN 1019745  
DI P>Upstate Biotechnology, Inc.  
DI 199 Saranac Avenue  
DI Lake Placid, NY 12946 USA  
DI 1-617-890-8845  
DI 1-800-233-3991 (toll free USA) (sales)  
DE P>05-275 ;distributor  
DO G>Mus musculus CN>mouse S>BALB/c O>spleen  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>CD61  
RE 1.a.CC>differentiation 1.b.CC>protein  
AP ;immunocytochemistry  
AV ;ascites  
SD 05275  
LD USA JMJ  
EI DA>9611  
CI ;catalog

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1020416 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
AN 1020416  
DI P>PanVera Corporation  
DI 545 Science Drive  
DI Madison, WI 53711 USA  
DI 1-800-791-1400  
DI 1-608-233-9450  
DE C>PL8-5 ;distributor  
DE P>TAK M068 ;distributor  
DO G>Mus musculus CN>mouse S>BALB/c O>spleen  
PD ;IgG  
RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
RE 1.a.CC>differentiation 1.b.CC>protein  
AV ;purified  
SD PL85  
SD TAKM068  
LD USA JMJ  
EI DA>9702  
CI ;catalog

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1020417 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
AN 1020417  
DI P>PanVera Corporation  
DI 545 Science Drive  
DI Madison, WI 53711 USA  
DI 1-800-791-1400  
DI 1-608-233-9450  
DE C>PL11-7 ;distributor  
DE P>TAK M069 ;distributor  
DO G>Mus musculus CN>mouse S>BALB/c O>spleen  
PD ;IgG  
RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
RE 1.a.CC>differentiation 1.b.CC>protein  
AV ;purified  
SD PL117  
SD TAKM069  
LD USA JMJ  
EI DA>9702  
CI ;catalog

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1021005 RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
AN 1021005  
DI P>Cortex Biochem, Inc.  
DI 1933 Davis Street, Suite 321  
DI San Leandro, CA 94577 USA  
DI 1-800-888-7713 (toll free USA)  
DI 1-510-568-3911 (technical)  
DE P>CR1153 ;distributor  
RE 1.G>Homo sapiens 1.CN>human 1.CE>platelet 1.SN>CD61  
RE 1.a.CC>differentiation  
RE 2.G>Homo sapiens 2.CN>human 2.CE>megakaryocyte 2.SN>CD61  
RE 2.a.CC>differentiation  
LD USA CLB  
EI DA>9704  
CI ;catalog

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1011328 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
AN 1011328  
DI P>Chemicon International, Inc.  
DI 28835 Single Oak Dr.  
DI Temecula, CA 92590 USA  
DI 1-909-676-8080  
DI 1-800-437-7500(toll free USA)  
DI 2.P>Life Technologies, Inc.  
DI 8400 Helgerman Ct.  
DI P.O. Box 6009  
DI Gaithersburg, MD 20884-9980 USA  
DI 1-301-840-8000  
DI 1-800-828-6686 (Toll free USA)  
DE P>MAB1958 ;distributor  
DE P>VNR147 ;distributor  
DE 2.P>12084-018 ;distributor  
DE 2.P>VNR147 ;distributor  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
RE 1.a.CC>receptor  
AV ;ascites ;2.ascites  
SD 12084018  
SD MAB1958  
SD VNR147  
LD USA BAL  
EI DA>9706 CV>9108  
CI ;catalog

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1011329 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
AN 1011329  
DI P>Chemicon International, Inc.  
DI 28835 Single Oak Dr.  
DI Temecula, CA 92590 USA  
DI 1-909-676-8080  
DI 1-800-437-7500(toll free USA)  
DI 2.P>Life Technologies, Inc.  
DI 8400 Helgerman Ct.  
DI P.O. Box 6009  
DI Gaithersburg, MD 20884-9980 USA  
DI 1-301-840-8000  
DI 1-800-828-6686 (Toll free USA)  
DE P>MAB1960 ;distributor  
DE P>VNR139 ;distributor  
DE 2.P>12085-015 ;distributor  
DE 2.P>VNR139 ;distributor  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
RE 1.a.CC>receptor  
AV ;ascites ;2.ascites  
SD 12085015  
SD MAB1960  
SD VNR139  
LD USA BAL  
EI DA>9706 CV>9108  
CI ;catalog

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1011842 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
AN 1011842  
DI P>Biogenesis Ltd.  
DI 7 New Fields  
DI Stinsford Road  
DI Poole BH17 7NF, England  
DI UK  
DI 44-1202 660006  
DE C>1U4/1 ;developer  
DE P>5355-2505 ;distributor  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
RE 1.a.CC>protein  
AP ;immunoblotting  
AV ;ascites  
SD 1U41  
SD 53552505  
LD USA BAL  
EI DA>9109 CV>9110  
CI ;catalog



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1011843 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
AN 1011843  
DI P>Biogenesis Ltd.  
DI 7 New Fields  
DI Stinsford Road  
DI Poole BH17 7NF, England  
DI UK  
DI 44-1202 660006  
DE C>1U3/0 ;developer  
DE P>5355-2515 ;distributor  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
RE 1.a.CC>protein  
AP ;immunofluorescence  
AV ;ascites  
SD 1U30  
SD 53552515  
LD USA BAL  
EI DA>9109 CV>9110  
CI ;catalog

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1012705 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
AN 1012705  
DI P>Chemicon International, Inc.  
DI 28835 Single Oak Dr.  
DI Temecula, CA 92590 USA  
DI 1-909-676-8080  
DI 1-800-437-7500(toll free USA)  
DE P>LM142 ;distributor  
DE P>MAB1978 ;distributor  
PD ;IgG  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
RE 1.a.CC>protein  
AV ;ascites  
SD LM142  
SD MAB1978  
LD USA BAL  
EI DA>9112 CV>9201  
CI ;catalog

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1013223 RE 1.SN>integrin alpha V 1.a.CC>protein  
AN 1013223  
DI P>American Qualex International, Inc.  
DI 920-A Calle Negocio St.  
DI San Clemente, CA 92673  
DI 1-714-521-3753  
DI 1-800-772-1776 (toll free USA)  
DE P>M2580 ;distributor  
RE 1.SN>integrin alpha V 1.a.CC>protein  
SD M2580  
LD USA BAL  
EI DA>9204 CV>9204  
CI ;catalog

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1013510 RE 1.G>Homo sapiens 1.CN>human 1.CE>endothelial cell  
AN 1013510  
AU Freed E  
SO EMBO J 1989;8:2955  
DI P>Calbiochem Novabiochem International  
DI P.O. Box 12087  
DI La Jolla, CA 92039-2087  
DI 1-800-854-3417(toll free USA)  
DI 1-619-450-9600  
DE P>407281 ;distributor  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.CE>endothelial cell  
RE 1.SN>integrin alpha V 1.FS>type 1 1.a.CC>protein  
RE 2.G>Homo sapiens 2.CN>human 2.SN>vitronectin  
RE 2.a.CC>protein  
RE 3.G>Homo sapiens 3.CN>human 3.SN>fibrinogen  
RE 3.a.CC>protein  
RE 4.G>Homo sapiens 4.CN>human 4.SN>osteopontin  
RE 4.a.CC>protein  
RE 5.G>Homo sapiens 5.CN>human 5.SN>von Willebrand factor  
RE 5.a.CC>protein  
RE 6.G>Homo sapiens 6.CN>human 6.O>bone 6.SN>sialoprotein I  
RE 6.a.CC>protein  
AP ;ELISA ;immunofluorescence ;immunoprecipitation  
AV ;ascites ;lyophilized  
SD 407281  
LD USA BAL  
EI DA>9303  
CI ;catalog  
SN Synonym>fibrinogen  
SN Synonym>von Willebrand factor

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1013511 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
AN 1013511  
DI P>Calbiochem Novabiochem International  
DI P.O. Box 12087  
DI La Jolla, CA 92039-2087  
DI 1-800-854-3417(toll free USA)  
DI 1-619-450-9600  
DE P>407282 ;distributor  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
RE 1.FS>type 2 1.a.CC>protein  
RE 2.G>Homo sapiens 2.CN>human 2.SN>vitronectin  
RE 2.a.CC>protein  
RE 3.G>Homo sapiens 3.CN>human 3.SN>fibrinogen  
RE 3.a.CC>protein  
RE 4.G>Homo sapiens 4.CN>human 4.SN>osteopontin  
RE 4.a.CC>protein  
RE 5.G>Homo sapiens 5.CN>human 5.SN>von Willebrand factor  
RE 5.a.CC>protein  
RE 6.G>Homo sapiens 6.CN>human 6.O>bone 6.SN>sialoprotein I  
RE 6.a.CC>protein  
AP ;ELISA ;immunoblotting  
AV ;ascites ;lyophilized  
SD 407282  
LD USA BAL  
EI DA>9303  
CI ;catalog  
SN Synonym>fibrinogen  
SN Synonym>von Willebrand factor

- 113 -

1014225 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V beta 5  
AN 1014225  
AU Wayner EA  
SO J Cell Biol 1991;113:919  
DI P>Becton Dickinson Immunocytometry Systems  
DI 2350 Qume Drive  
DI San Jose, CA 95131-1807  
DI 1-800-223-8226 (toll free USA)  
DI 1-408-954-2347  
DI 2.P>Chemicon International, Inc.  
DI 28835 Single Oak Dr.  
DI Temecula, CA 92590 USA  
DI 1-909-676-8080  
DI 1-800-437-7500 (toll free USA)  
DI 3.P>Life Technologies, Inc.  
DI 8400 Helgerman Ct.  
DI P.O. Box 6009  
DI Gaithersburg, MD 20884-9980 USA  
DI 1-301-840-8000  
DI 1-800-828-6686 (Toll free USA)  
DI 4.P>Telios Pharmaceuticals, Inc.  
DI 4757 Nexus Centre Drive  
DI San Diego, CA 92121 USA  
DI 1-619-622-2650  
DE C>P1F6 ;developer  
DE P>550045 ;distributor  
DE P>P1F6 ;distributor  
DE 2.P>MAB1961 ;distributor  
DE 2.P>P1F6 ;distributor  
DE 3.P>12078-010 ;distributor  
DE 3.P>P1F6 ;distributor  
DE 4.P>A035 ;distributor  
DO G>Mus musculus CN>mouse  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V beta 5  
RE 1.a.CC>receptor  
AP ;immunofluorescence ;immunoprecipitation  
AV ;2.ascites ;3.ascites ;4.ascites  
SD 12078010  
SD 550045  
SD A035  
SD MAB1961  
SD P1F6  
LD USA BAL  
EI DA>9706  
CI ;catalog

- 114 -

1014277 RE 1.G>Homo sapiens 1.CN>human 1.CE>endothelial cell  
AN 1014277  
DI P>Bio-Science Products AG  
DI Gerliswilstrasse 43  
DI Postfach 1173  
DI CH-6020 Emmenbrucke, Switzerland  
DI 41-555875  
DE P>0121005 ;distributor  
RE 1.G>Homo sapiens 1.CN>human 1.CE>endothelial cell  
RE 1.SN>integrin alpha V 1.a.CC>receptor  
RE 2.G>Homo sapiens 2.CN>human 2.PA>carcinoma  
RE 2.SN>integrin alpha V 2.a.CC>neoplasm 2.b.CC>receptor  
NR 1.G>Homo sapiens 1.CN>human 1.SN>fibronectin receptor  
NR 1.a.CC>receptor  
NR 2.G>Homo sapiens 2.CN>human 2.SN>CD41  
NR 2.a.CC>differentiation  
AP ;ELISA ;immunofluorescence ;not immunoblotting  
AP ;immunoprecipitation  
LD USA BAL  
EI DA>9305  
CI ;catalog  
SN Synonym>CD41 1014277 SN Synonym>CD41  
SN Synonym>fibronectin receptor

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1014278 RE 1.G>Homo sapiens 1.CN>human 1.CE>endothelial cell  
AN 1014278  
DI P>Bio-Science Products AG  
DI Gerliswilstrasse 43  
DI Postfach 1173  
DI CH-6020 Emmenbrucke, Switzerland  
DI 41-555875  
DE P>0121006 ;distributor  
AS ;immunoblot  
RE 1.G>Homo sapiens 1.CN>human 1.CE>endothelial cell  
RE 1.SN>integrin alpha V 1.a.CC>receptor  
RE 2.G>Homo sapiens 2.CN>human 2.PA>carcinoma  
RE 2.SN>integrin alpha V 2.a.CC>neoplasm 2.b.CC>receptor  
AP ;immunoassay  
LD USA BAL  
EI DA>9305  
CI ;catalog



- 116 -

1023559 RE 1.G>Mus musculus 1.CN>mouse 1.SN>integrin alpha V  
SO Biochemistry 1990;29:10191  
SO Exp Cell Res 1993;205:25  
DI P>Upstate Biotechnology, Inc.  
DI 199 Saranac Avenue  
DI Lake Placid, NY 12946 USA  
DI 1-617-890-8845  
DI 1-800-233-3991 (toll free USA) (sales)  
DE P>05-437 ;distributor  
DO G>Mus musculus CN>mouse  
RE 1.G>Mus musculus 1.CN>mouse 1.SN>integrin alpha V  
RE 1.MW>160 kD 1.a.CC>differentiation 1.b.CC>receptor  
AP ;Western blot ;immunoprecipitation ;immunohistochemistry  
AV ;ascites  
AB Reactant is also known as vitronectin receptor alpha subunit and  
CD51.  
SD 05437  
LD USA MCM  
EI DA>9807  
CI ;catalog

- 117 -

1023927 RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
AN 1023927  
SO J Biol Chem 1994;269:6940  
DI P>Chemicon International, Inc.  
DI 28835 Single Oak Dr.  
DI Temecula, CA 92590 USA  
DI 1-909-676-8080  
DI 1-800-437-7500 (toll free USA)  
DE C>P3G8 ;distributor  
IM G>Homo sapiens CN>human O>lung PA>carcinoma a.CC>neoplasm  
DO G.Mus musculus CN>mouse  
PD ;IgG1  
RE 1.G>Homo sapiens 1.CN>human 1.SN>integrin alpha V  
RE 1.a.CC>differentiation 1.b.CC>receptor  
AP ;immunocytology ;immunohistochemistry ;immunoprecipitation  
AP ;flow cytometry ;ELISA ;FACS  
AV ;purified  
AB Reactant is also known as CD51 and vitronectin receptor alpha subunit.  
AB Product reacts with all alpha V-containing integrin receptors.  
AB Product will react with some lymphoid cell lines (B cells), many  
AB carcinoma and melanoma cell lines and osteosarcomas.  
SD MAB1953  
SD P3G8  
LD USA MCM  
EI DA>9808  
CI ;catalog

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**CLAIMS:**

1. A method of treating mammalian dendritic cells in vitro to induce immune tolerance therein  
5 which comprises exposing said cells to an agonist of the cell surface receptors CD36 and/or CD51 as expressed on mammalian dendritic cells.
2. A method as claimed in claim 1 wherein said  
10 dendritic cells are human or mouse.
3. A method as claimed in claim 1 or 2 wherein said agonist is a molecule identified as such by any one of the methods of claims 15 to 32.  
15
4. A method as claimed in claim 1 or 2 wherein said agonist is selected from: an antibody with an affinity for an epitope of CD36, an antibody with an affinity for an epitope of CD51, the Plasmodium  
20 falciparum protein pf-EMP-1, a protein comprising the active binding domain of pf-EMP-1, thrombospondin, apoptotic cells or a negatively charged phospholipid.
5. A method as claimed in claim 1 or 2 which  
25 comprises exposing said dendritic cells to two or more of the agonists of claim 4.
6. A method as claimed in claim 4 or claim 5 wherein the CD36 agonist any one of the antibodies  
30 listed in Appendix 1.
7. A method as claimed in claim 4 or claim 5 wherein the CD51 agonist is any one of the antibodies listed in Appendix 2.  
35
8. A method as claimed in claim 4 or claim 5

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wherein the pf-EMP-1 active binding domain comprises the amino acid sequence shown in Figure 2.

5           9. A method as claimed in any one of claims 40 to 47 wherein said cells are exposed to an antigenic material.

10           10. A method as claimed in claim 9 wherein said antigenic material is an auto-antigen associated with a particular auto-immune disease.

15           11. A method as claimed in claim 9 or 10 wherein the cells so produced are subsequently matured by exposure to an immune stimulus.

20           12. A method as claimed in any of claims 1 to 11 wherein said dendritic cells are prepared from human peripheral blood and or derived from CD34+ stem cells or monocytes.

          13. A dendritic cell preparation obtainable by the method of any of claims 1 to 12 for use as a medicament.

25           14. A dendritic cell preparation obtainable by the method of any of claims 1 to 12 for use in inducing peripheral immune tolerance in a human.

30           15. A method of identifying a molecule which is an agonist of cell surface receptor CD36 and/or CD51 as expressed by mammalian dendritic cells which method comprises:

a) exposing immature mammalian dendritic cells to the molecule to be tested,

35           b) exposing said immature dendritic cells to an immune stimulus and

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c) determining the degree of maturation manifested by said dendritic cells,

wherein impaired maturation in response to the immune stimulus is an indication that said molecule  
5 under test is a CD36 and/or CD51 agonist.

16. A method as claimed in claim 15 wherein said dendritic cells are human cells or mouse cells.

10 17. A method as claimed in claim 15 or 16 wherein maturation of said dendritic cells is determined by examining the antigen-presenting ability of said cells.

15 18. A method as claimed in any of claims 15 to 17 wherein maturation of said dendritic cells is determined by examining said cells for expression of at least one cell surface antigen whose level of expression is enhanced in response to an immune  
20 stimulus.

19. A method as claimed in claim 18 wherein maturation of said dendritic cells is determined by measuring the level of expression of one or more of  
25 the following panel of antigens:  
HLA DR, CD54, CD40, CD83 and CD86.

20. A method as claimed in claim 19 wherein said cells are also examined for expression of CD80.  
30

21. A method as claimed in any one of claims 18 to 20 wherein the level of expression of said antigens is detected using a labelled antibody.

35 22. A method as claimed in 15 or 16 wherein maturation of said dendritic cells is determined by measuring said cells' ability to induce T-cell

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proliferation.

23. The method of claim 15 or 16 wherein  
maturation of said dendritic cells is determined by  
5 quantifying the level of cytokines secreted from said  
cells.

24. The method of claim 23 wherein the level of  
secretion TNF $\alpha$ , IL12P70 and IL10 is measured.  
10

25. A method as claimed in any one of claims 15  
to 24 wherein said immune stimulus is  
lipopolysaccharide, TNF $\alpha$ , CD40L or monocyte  
conditioned medium (MCM).  
15

26. A method as claimed in any one of claims 15  
to 25 wherein if said test molecule is found to be a  
potential agonist of CD36 and/or CD51 the method  
further comprises the step of exposing said molecule  
20 to a purified sample of CD36 and/or CD51 and  
detecting any direct binding between said molecule  
and CD36 and/or CD51.

27. A method as claimed in claim 26 wherein said  
25 purified CD36 or CD51 is immobilised to a solid  
surface.

28. A method as claimed in claim 26 or claim 27  
wherein said molecule is labelled with a detectable  
30 label.

29. A method as claimed in any of claims 26 to  
28 which further comprises the step of exposing said  
molecule to a purified sample of  $\alpha_v\beta_3$  or  $\alpha_v\beta_5$  and  
35 detecting any direct binding between said molecule and  
said  $\alpha_v\beta_3$  or  $\alpha_v\beta_5$ .

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30. A method as claimed in any one of claims 26 to 29 which further comprises the step of exposing said molecule to a purified sample of thrombospondin and detecting any direct binding between said molecule and thrombospondin.

31. A method as claimed in claim 29 or claim 30 wherein said molecule is labelled with a detectable label.

32. A method as claimed in any of claims 29 to 31 wherein said  $\alpha_v\beta_3$ ,  $\alpha_v\beta_5$  or thrombospondin is immobilised to a solid surface.

33. A pharmaceutical composition suitable for inducing peripheral immune tolerance in a mammal which comprises an agonist of the cell surface receptor CD36 as expressed on mammalian dendritic cells and a pharmacologically acceptable carrier or diluent.

34. A composition as claimed in claim 33 which is suitable for inducing peripheral immune tolerance in a human wherein said CD36 agonist is selected from: an antibody with an affinity for an epitope of CD36, the Plasmodium falciparum protein pf-EMP-1, a protein comprising the active binding domain of pf-EMP-1 for CD36 and/or thrombospondin, thrombospondin, apoptotic cells or a negatively-charged phospholipid.

35. A composition as claimed in claim 20 wherein said CD36 agonist is any one of the antibodies listed in Appendix 1.

36. A composition as claimed in claim 20 wherein the pf-EMP-1 active binding domain comprises the amino acid sequence as shown in Figure 2.

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37. A composition as claimed in claim 19 wherein said CD36 agonist is a molecule identified as such by any one of the methods of claims 15 to 32.

5           38. An agonist of the cell surface receptor CD36 as expressed on mammalian dendritic cells for use as a medicament.

10           39. An agonist for use as claimed in claim 38 wherein said medicament is used to induce a state of immune tolerance in a human.

15           40. An agonist for use as claimed in claim 38 or 39 which is suitable for treating a human and wherein said CD36 agonist is selected from: an antibody with an affinity for an epitope of CD36, the Plasmodium falciparum protein pf-EMP-1, a protein comprising the active binding domain of pf-EMP-1 for CD36 or thrombospondin, thrombospondin, apoptotic cells or a  
20           negatively charged phospholipid.

25           41. An agonist for use as claimed in claim 40 wherein said CD36 agonist is any one of the antibodies listed in Appendix 1.

          42. An agonist for use as claimed in claim 40 wherein the pf-EMP-1 active binding domain comprises the amino acid sequence as shown in Figure 2.

30           43. A pharmaceutical composition suitable for inducing peripheral immune tolerance in a mammal which comprises an agonist of the cell surface receptor CD51 as expressed by mammalian dendritic cells and a pharmacologically acceptable carrier or diluent.

35           44. A composition as claimed in claim 43 suitable for inducing immune tolerance in a human



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wherein said CD51 agonist is selected from: an antibody with an affinity for an epitope of CD51, thrombospondin, apoptotic cells or a negatively charged phospholipid.

5

45. A composition as claimed in claim 44 wherein said CD51 agonist is any one of the antibodies listed in Appendix 2.

10

46. A composition as claimed in claim 43 or 44 which comprises the Plasmodium falciparum protein pf-EMP-1 or a protein comprising an active binding domain thereof and thrombospondin.

15

47. A composition as claimed in claim 46 wherein said active binding domain of pf-EMP-1 comprises the amino acid sequence shown in Figure 2.

20

48. A composition as claimed in claim 43 wherein said CD51 agonist is a molecule identified as such by any one of the methods of claims 15 to 32.

25

49. An agonist of the cell surface receptor CD51 as expressed on mammalian dendritic cells for use as a medicament.

30

50. An agonist for use as claimed in claim 49 wherein said medicament is used to induce a state of immune tolerance in a human.

35

51. An agonist for use as claimed in claim 49 or 50 which is suitable for administration to a human wherein said CD 51 agonist is selected from: an antibody with an affinity for an epitope of CD51, thrombospondin, apoptotic cells or a negatively charged phospholipid.

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52. An agonist for use as claimed in claim 51 wherein said CD51 agonist is any one of the antibodies listed in Appendix 2.

5 53. An agonist for use as claimed in claim 49 which is suitable for administration to a human and which comprises, in combination, the Plasmodium falciparum protein pf-EMP-1 or a protein comprising an active binding domain thereof and thrombospondin.

10 54. Use of a method comprising the following steps for identifying a molecule capable of preventing the adherence of red blood cells infected with a malarial parasite to human dendritic cells:

15 a) exposing a purified preparation of the human cell surface receptor CD36 to:-

I) the molecule to be tested and

ii) parasitised human red blood cells, either consecutively or simultaneously and

20 b) determining the level of adherence of said parasitised red blood cells to CD36

wherein a reduction in the level of adherence in the presence of the test molecule compared to the level in the absence of said molecule is an indication that said molecule is capable of preventing the adherence of red blood cells infected with the malarial parasite to human dendritic cells.

30 55. Use of a method comprising the following steps for identifying a molecule capable of preventing the adherence of red blood cells infected with the malarial parasite to human dendritic cells:

a) exposing a purified preparation of human thrombospondin to:

35 I) the molecule to be tested and

ii) parasitised human red blood cells, either consecutively or simultaneously and

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b) determining the level of adherence of said parasitised red blood cells to thrombospondin,

wherein a reduction in the level of adherence to thrombospondin in the presence of the test molecule compared to the level in the absence of said molecule is an indication that said molecule is capable of preventing the adherence of red blood cells infected with the malarial parasite to human dendritic cells.

56. Use of a method as claimed in claim 54 or claim 55 wherein said red blood cells are infected with *Plasmodium falciparum*.

57. Use of a method as claimed in claim 56 wherein the *Plasmodium falciparum* strain is ITO/A4, ITO/C24 or MC.

58. Use of a method as claimed in claim 54 wherein said CD36 is immobilised on a solid surface.

59. Use of a method as claimed in claim 55 wherein said thrombospondin is immobilised on a solid surface.

60. Use of a method as claimed in claim 58 or claim 59 wherein the level of adherence of said parasitised red blood cells to CD36 or thrombospondin is determined by the additional steps of:

a) washing the immobilised CD36 or thrombospondin to remove non-adhered red blood cells and

b) applying a stain to said immobilised CD36 or thrombospondin which is specific for parasitised or non-parasitised red blood cells.

61. Use of a method as claimed in claim 60 wherein said stain is detectable by eye, by microscopy or by a spectrophotometric method.

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62. Use of a method as claimed in claim 54 which comprises applying simultaneously or consecutively the method of claim 55.

5

63. A method of identifying a molecule capable of preventing the adherence of red blood cells infected with a malarial parasite to human dendritic cells which comprises:

10 a) exposing immature human dendritic cells to the Plasmodium falciparum protein pf-EMP-1 or an active binding domain thereof in the presence or absence of the molecule to be tested,

15 b) exposing said immature dendritic cells to an immune stimulus and

c) determining the degree of maturation manifested by said dendritic cells,

20 wherein any maturation of said dendritic cells in the presence of the test molecule over and above that manifested in the absence of said molecule is an indication that said molecule is capable of preventing adherence of red blood cells infected with a malarial parasite to human dendritic cells.

25 64. A method as claimed in claim 63 wherein maturation of said dendritic cells is determined by examining the antigen-presenting ability of said cells.

30 65. A method as claimed in claim 63 or claim 64 wherein maturation of said dendritic cells is determined by examining said cells for expression of at least one cell surface antigen whose expression level is enhanced in response to an immune stimulus.

35

66. A method as claimed in claim 65 wherein maturation of said dendritic cells is determined by

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measuring the level of expression of two or more of the following panel of antigens:  
HLA DR, CD54, CD40, CD83 and CD86.

5           67. A method as claimed in claim 66 wherein said cells are also examined for expression of CD80.

68. A method as claimed in any one of claims 65 to 67 wherein the level of expression of said antigen  
10 is detected using a labelled antibody.

69. A method as claimed in claim 63 wherein maturation is determined by measuring said cells' ability to induce T-cell proliferation.  
15

70. A method as claimed in claim 63 wherein maturation of said dendritic cells is determined by quantifying the level of cytokines secreted from said cells.  
20

71. A method as claimed in claim 70 wherein the level of secretion of TNF $\alpha$ , IL12P70 and IL10 is measured.

25           72. A method as claimed in any one of claims 63 to 71 wherein said immune stimulus is lipopolysaccharide, TNF alpha, CD40L or monocyte conditioned medium (MCM).

30           73. A pharmaceutical composition useful for the treatment of malaria which comprises a molecule capable of preventing the adherence of red blood cells infected with the malarial parasite to human dendritic cells which has been identified by the method of any  
35 one of claims 63 to 72 and a pharmacologically acceptable carrier or diluent.

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74. A molecule identified as being capable of preventing the adherence of red blood cells infected with the malarial parasite to human dendritic cells by the method of any one of claims 63 to 72 for use in the treatment of malaria.

75. A pharmaceutical composition useful for the treatment of malaria which comprises a molecule capable of preventing the adherence of red blood cells infected with the malarial parasite to human dendritic cells which has been identified by the use of the method of any one of claims 54 to 62.

76. A molecule identified as being capable of preventing the adherence of red blood cells infected with the malarial parasite to human dendritic cells by use of the method as claimed in any one of claims 54 to 62.

77. A method of identifying a molecule which is an agonist of cell surface receptors CD36 and/or CD51 and/or a receptor for thrombospondin as expressed on antigen-presenting cells of the mammalian immune system which method comprises:

- a) exposing mammalian antigen-presenting cells to the molecule to be tested,
- b) exposing said cells to an immune stimulus and
- c) determining the response to said immune stimulus by said cells,

wherein an impaired response compared to the response in the absence of said test molecule is an indication that said molecule under test is a agonist of CD36 and/or CD51 and/or a thrombospondin receptor.

78. A method as claimed in claim 77 wherein said thrombospondin receptor is not CD47.

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79. A method as claimed in claim 77 or claim 78 wherein said response is maturation of said antigen-presenting cell.

5           80. A method as claimed in any one of claims 77 to 79 wherein said antigen-presenting cell of the immune system is selected from a dendritic cell, a macrophage, a B-lymphocyte or a monocyte.

10           81. A method as claimed in any of claims 77 to 80 which includes the features of any of claims 16 to 18 or 21 to 32.

15           82. A method of treating mammalian antigen-presenting cells in vitro to induce immune tolerance therein which comprises exposing said cells to an agonist of the cell surface receptor for thrombospondin and/or an agonist for the cell surface receptors CD36 and/or CD51.

20           83. A method as claimed in claim 82 wherein said antigen-presenting cell is human or mouse.

25           84. A method as claimed in claim 82 or 83 wherein said antigen presenting cell is selected from a dendritic cell, a macrophage, a B-lymphocyte or a monocyte.

30           85. A method as claimed in any one of claims 82 to 84 wherein said agonist is a molecule identified as such by the method of any one of claims 77 to 81.

35           86. A method as claimed in any one of claims 82 to 85 which includes the features of any one of claims 4 to 12.

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87. A method as claimed in any one of claims 82 to 85 wherein said antigen-presenting cells are exposed to an antibody to an epitope of a thrombospondin receptor.

5

88. A method as claimed in claim 87 wherein said agonist is any one of the antibodies listed in Appendix 3.

10

89. A method as claimed in claim 87 or claim 88, which includes the features of any of claims 9 to 12.

15

90. An antigen-presenting cell preparation obtainable by the method of any one of claims 82 to 89 for use as a medicament.

20

91. As antigen-presenting cell preparation obtainable by the method of any one of claims 82 to 89 for use in inducing peripheral immune tolerance in a human.

25

92. A method of identifying a molecule which is an agonist of a  $\beta$ -integrin associated with the cell surface receptor CD51 as expressed on antigen-presenting cells of the mammalian immune system which method comprises:

30

- a) exposing mammalian antigen-presenting cells to the molecule to be tested,
- b) exposing said cells to an immune stimulus and
- c) determining the response to said immune stimulus by said cells,

35

wherein an impaired response compared to the response in the absence of said test molecule is an indication that said molecule is an agonist of a  $\beta$ -integrin associated with the cell surface receptor CD51.



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93. A method as claimed in claim 92 which includes the features of claim 78 or claim 79

5 94. A method as claimed in claim 92 to 93 which further includes the features of any one of claims 16 to 25 or 29 to 32.

10 95. A method as claimed in any one of claims 92 to 94 wherein said  $\beta$ -integrin is  $\beta 3$  or  $\beta 5$ .

15 96. A pharmaceutical composition suitable for inducing peripheral immune tolerance in a mammal which comprises an agonist of a  $\beta$ -integrin associated with the cell surface receptor CD51 as expressed on mammalian antigen-presenting cells and a pharmacologically acceptable carrier or diluent.

20 97. A pharmaceutical composition as claimed in claim 96 wherein the  $\beta$ -integrin is  $\beta 3$  or  $\beta 5$ .

25 98. A method of inducing a state of immune tolerance in antigen-presenting cells of the mammalian immune system which comprises exposing said cells *ex vivo* to an agonist of a  $\beta$ -integrin.

99. A method as claimed in claim 97 wherein said  $\beta$ -integrin is  $\beta 3$  or  $\beta 5$ .

30 100. A method as claimed in claim 97 to 98 wherein said antigen presenting cells are human.

35 101. A method as claimed in claim 97 or 99 wherein said cells are exposed to an antigenic material.

102. A preparation of cells obtainable by the method as claimed in any one of claims 97 to 100 for

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use as a medicament.

5       103. A preparation of cells obtainable by the method as claimed in any one of claims 97 to 100 for use in inducing immune-tolerance in a human.

10       104. A pharmaceutical composition suitable for inducing peripheral immune tolerance in a mammal which comprises an agonist of a thrombospondin receptor and a pharmacologically acceptable carrier or diluent.

      105. A composition as claimed in claim 104 wherein said thrombospondin receptor is not CD47.

15       106. A preparation of apoptotic cells for use in inducing peripheral immune tolerance in a mammal.

      107. A preparation as claimed in claim 106 wherein said mammal is a human.

20       108. A preparation comprising a negatively charged phospholipid for use in inducing peripheral immune tolerance in a mammal.

25       109. A preparation as claimed in claim 108 wherein said mammal is a human.

30       110. A preparation as claimed in claim 108 or 109 which comprises liposomes including a negatively charged phospholipid.

      111. A preparation as claimed any one of claims 108 to 110 wherein said negatively charged phospholipid is phosphatidylserine.

35       112. A method of inducing a state of immune tolerance in antigen-presenting cells of the mammalian

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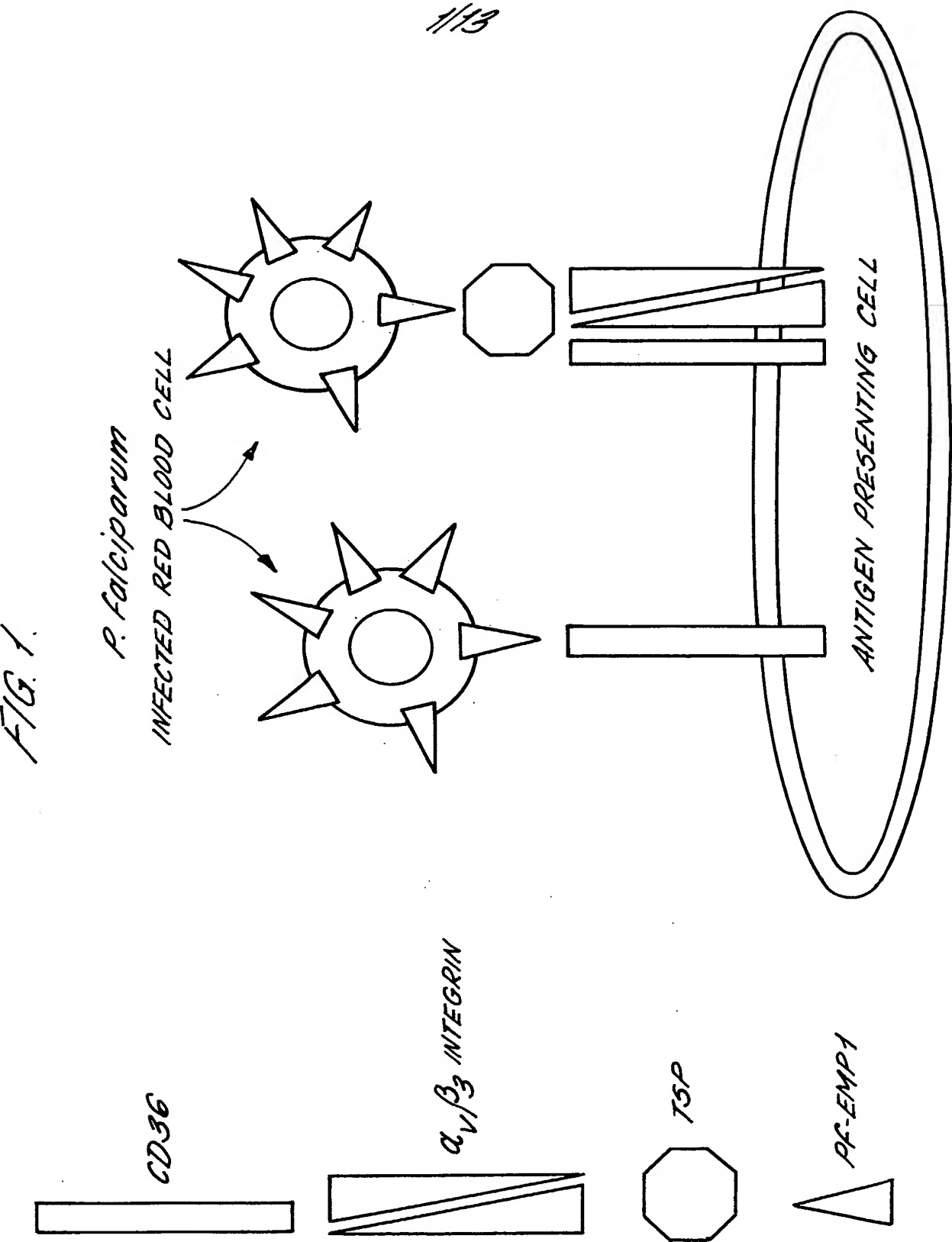
immune system which comprises exposing said cells ex-vivo to a composition or preparation as claimed in any one of claims 104 to 111.

5           113. A method as claimed in claim 112 wherein said cells are exposed to an antigenic material.

          114. A preparation of antigen-presenting cells obtainable by the method of claims 112 or 113.

10

          115. A method of treating a human to induce peripheral immune tolerance therein comprising administering to said human a substance selected from the group consisting of: an agonist of CD36, an  
15 agonist of CD51, an agonist of a thrombospondin receptor, an agonist of a  $\beta$ -integrin and a preparation of cells of any of claims 13, 14, 90, 91, 102 or 114.



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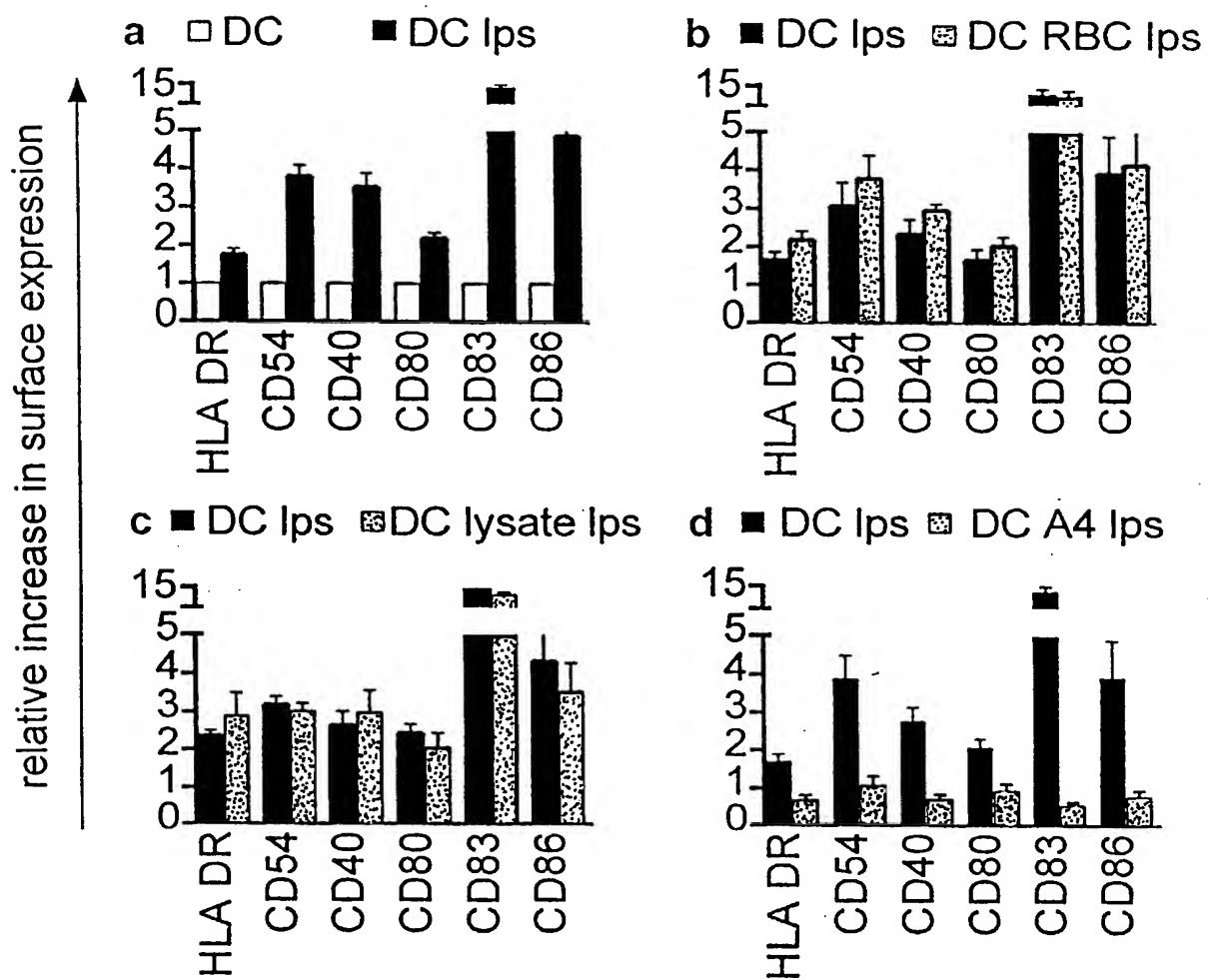
FIG. 2.

**AMINO ACID SEQUENCE OF THE CIDR FRAGMENT OF THE A4-VAR  
GENE (COMPLETE SEQUENCE ACCESSION NO L42244)**

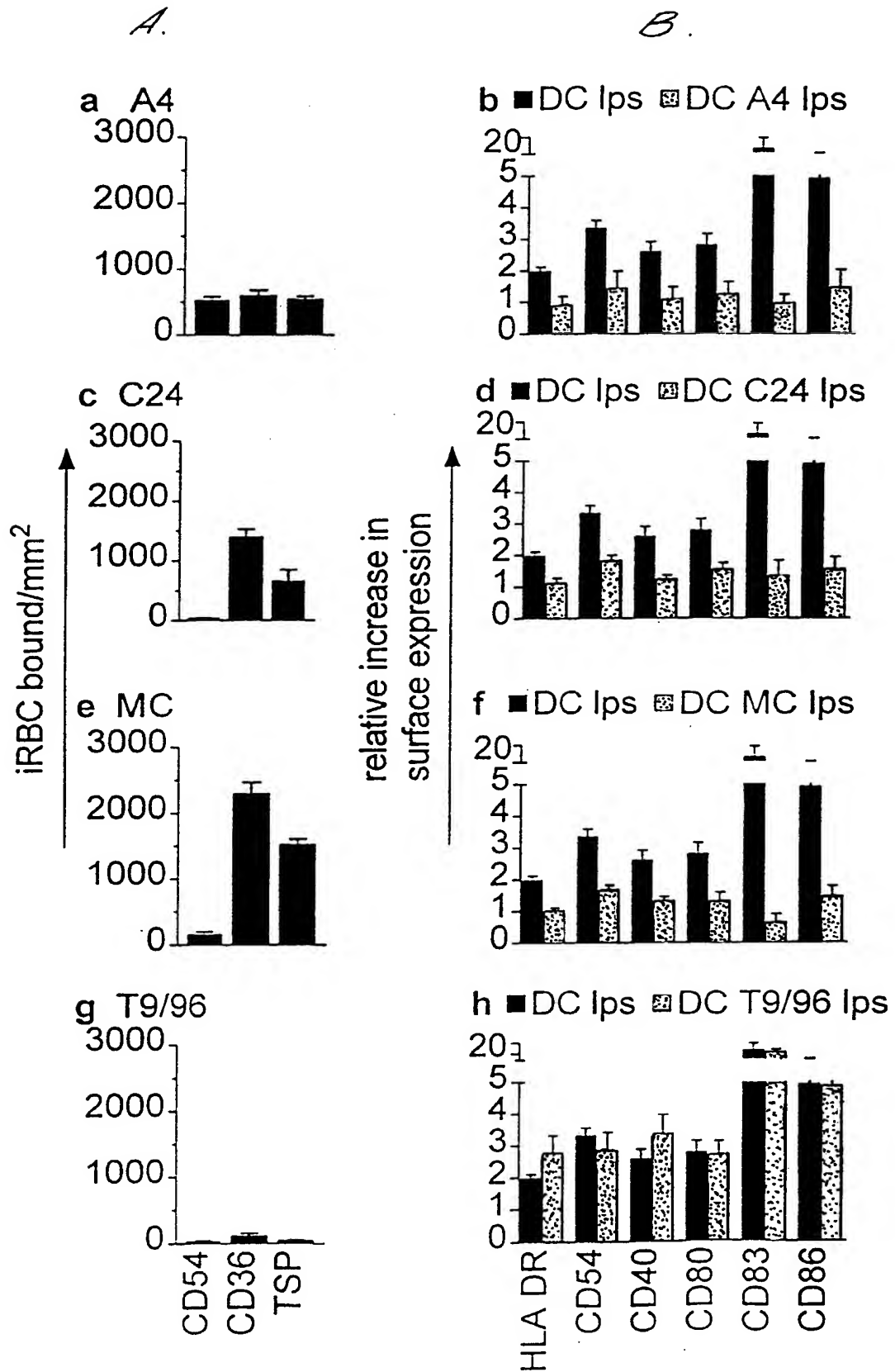
402- TDEIKKNDD TTITTEYGTI NNMYRKDFYK HLEEKYKTVD  
AFLNLLNKEK ECKNHPEVGE GKKKYIDFND NIETFSHTEY  
REPCPWCIE EQKDGGKWKRI NDHSACKEEE LYTPKENAKY  
TKINVLTSGE GHEDIAKRLK EFCTKTQNGG GGSDDCGGNS  
DSSLCEPWQC YQPDQLEKVG GGEVDDKLKG AGGLCIFEKM  
KGEKKVKKQK TFNNFFNFWV AHVLKDSIDW RTQLTKCLSE  
DKLKKCEKGC KSNCECFKKW IEKKEKEWIK VKDQFNKQTD  
FLEWKHYLVL ETILENYYFE NIQKAYGDLK SIQEMKKMIK  
ENKQKNRRTK DDEDALDVLF DHEKEEAEDC LDIHEDDDDD  
DECVEEIEKI FNNPCSGTRH RAMVKNVAAD MYRAARQQLR  
NRAGGRKTLR ADASQGHYNG KANESVLKDV CDITNQY\$NA  
IGDSKD -846

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FIG. 3.

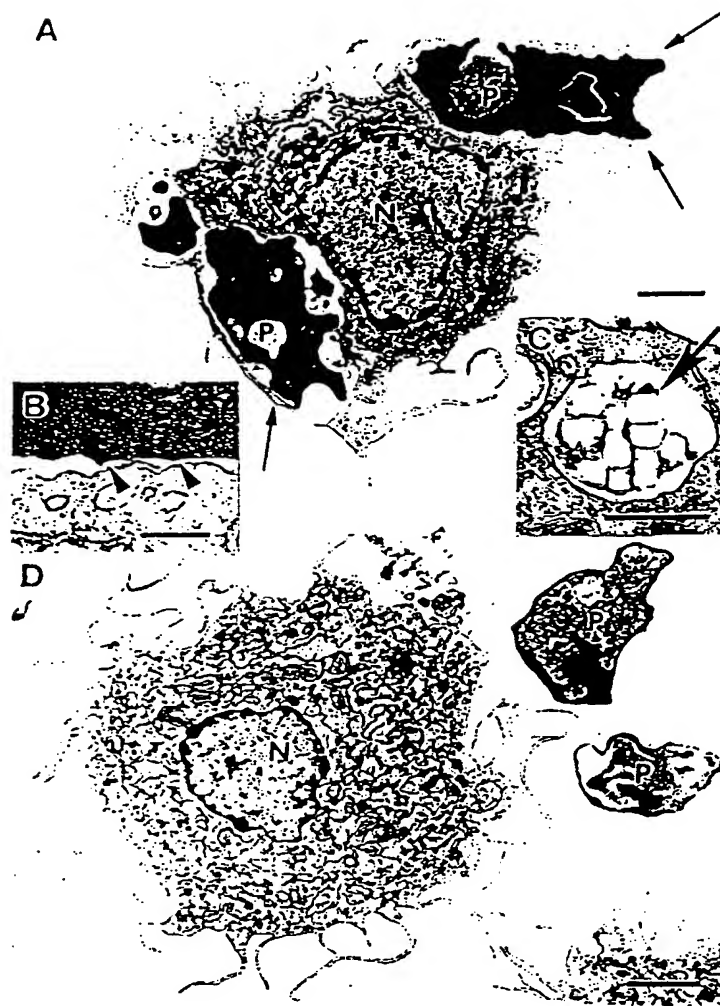


4/13  
FIG. 4.



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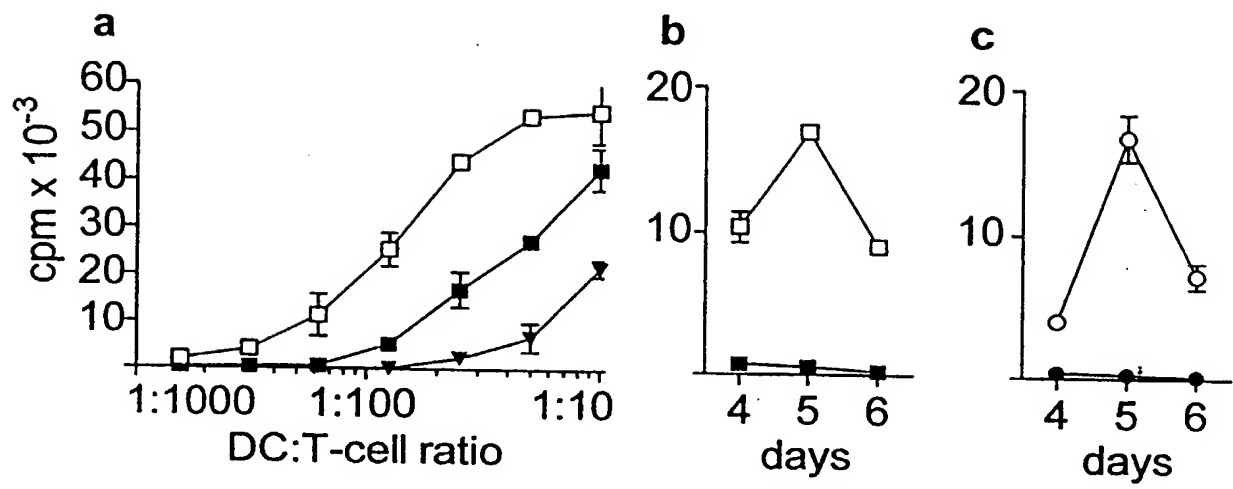
FIG. 5.





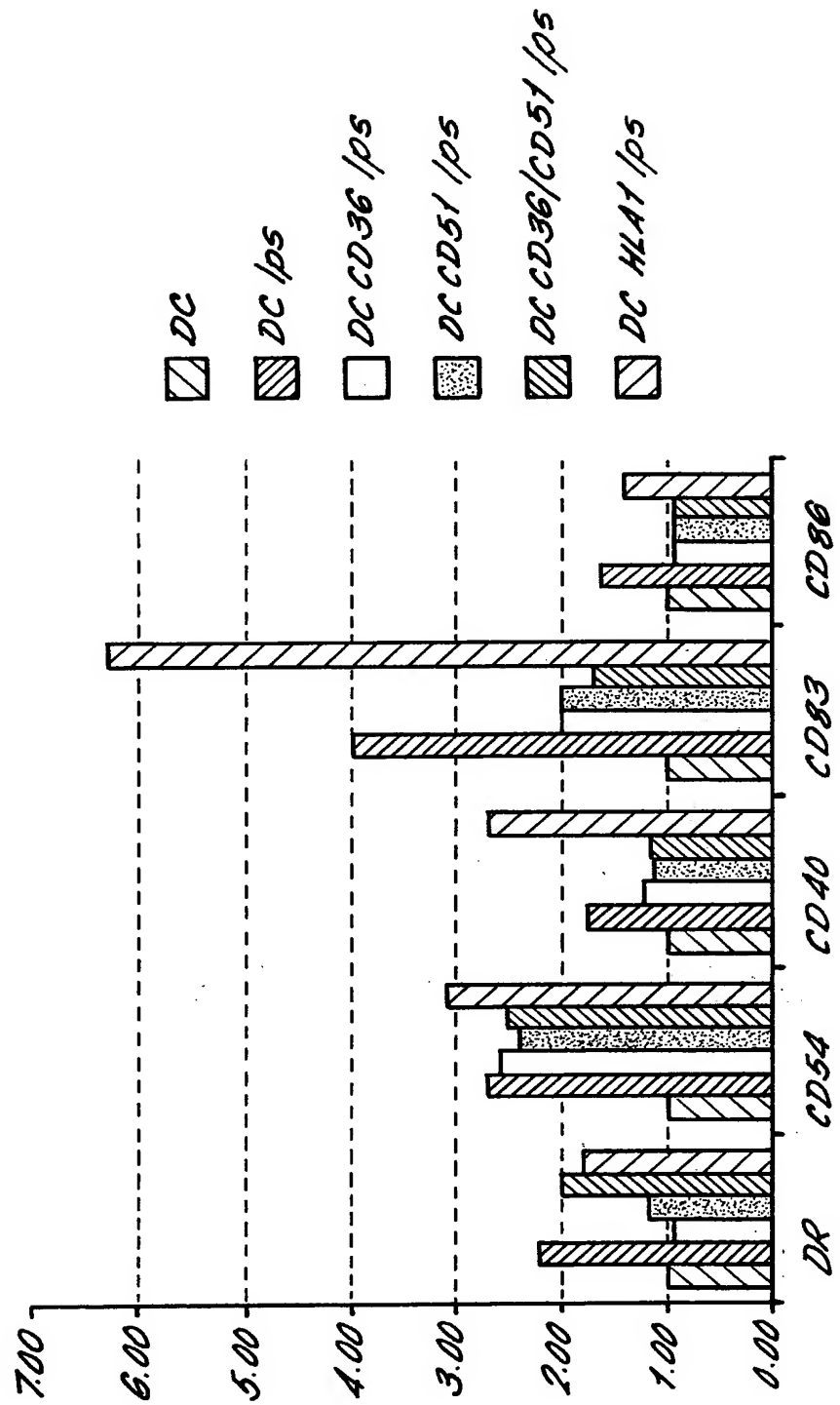
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FIG. 6.

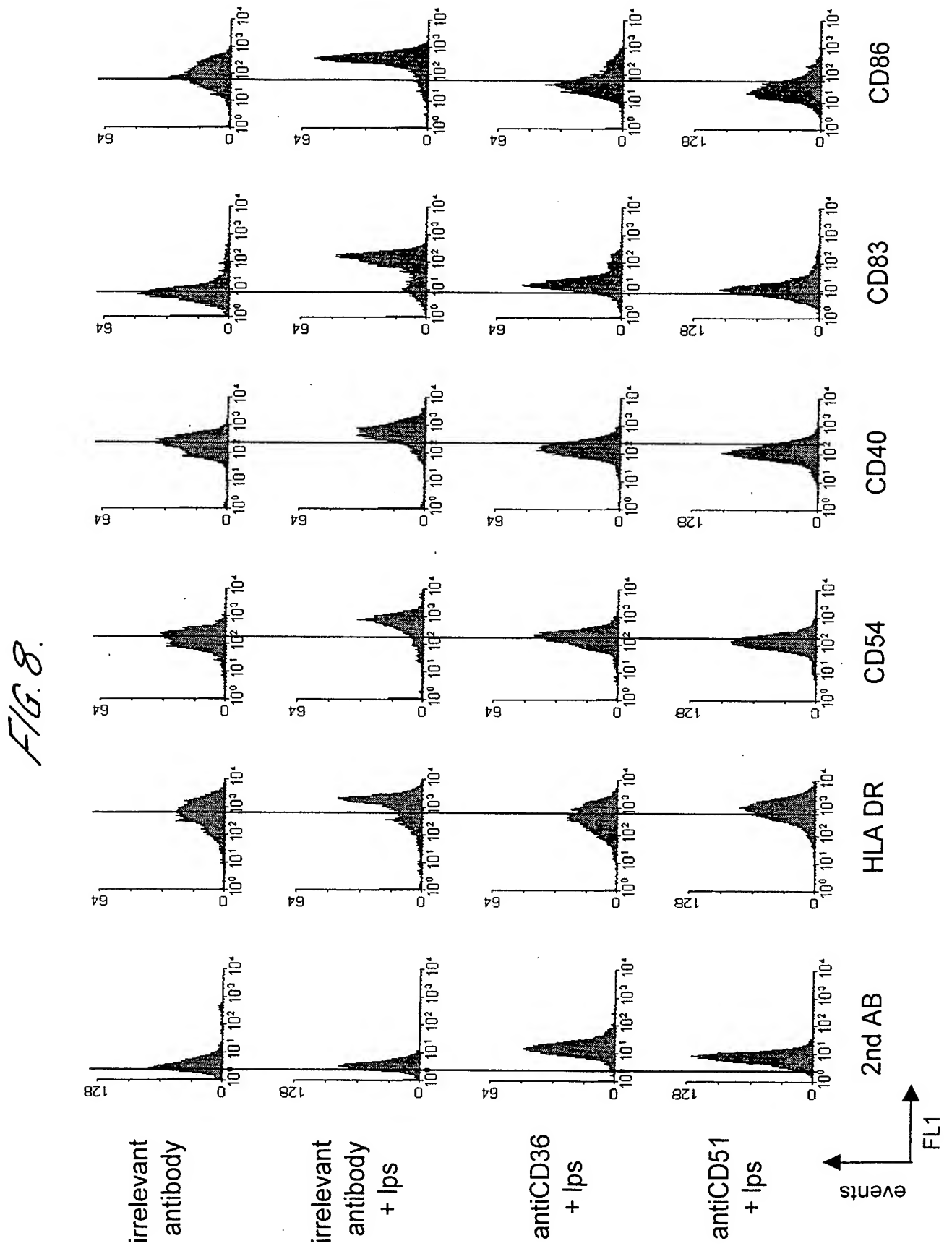


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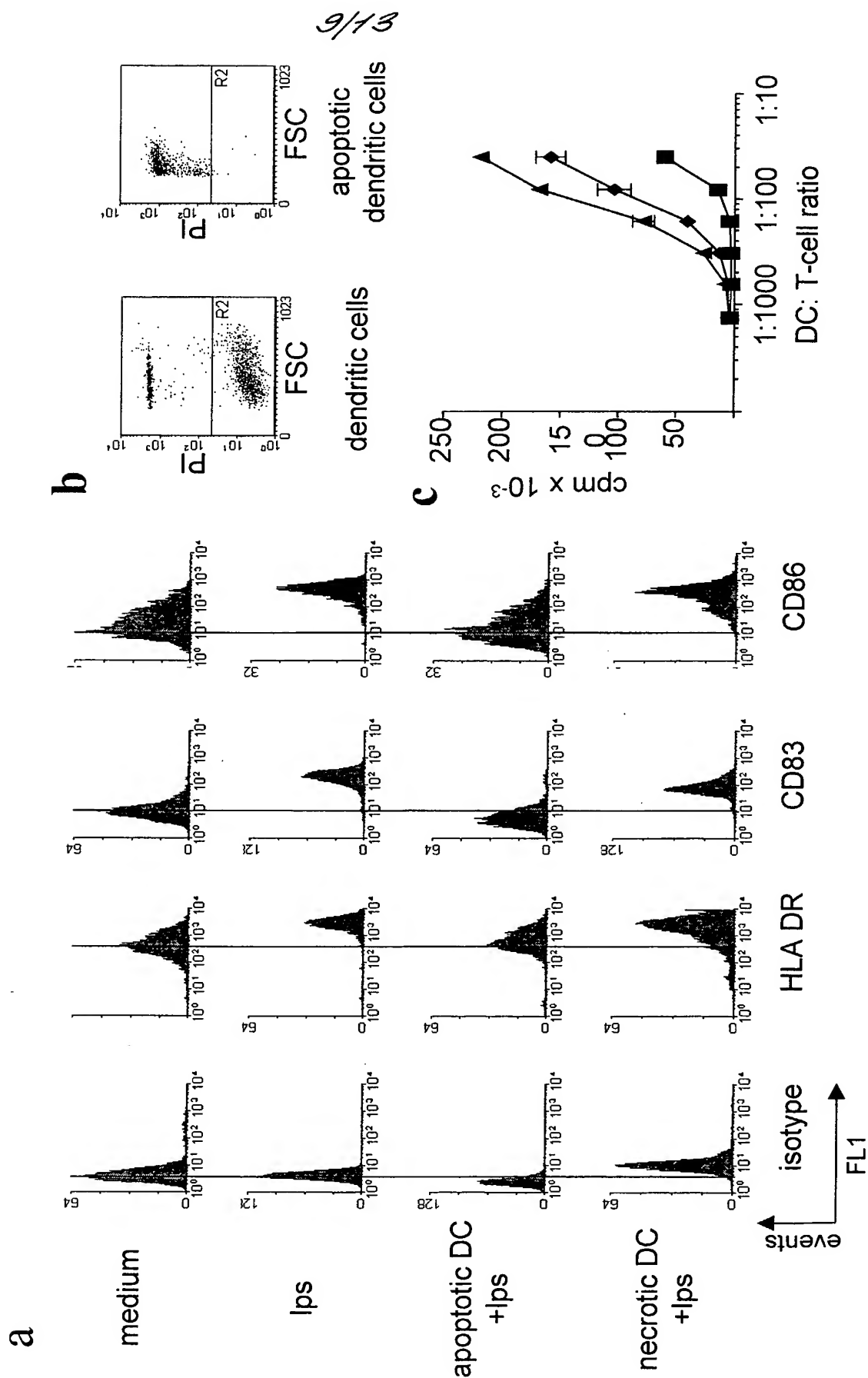
FIG. 7



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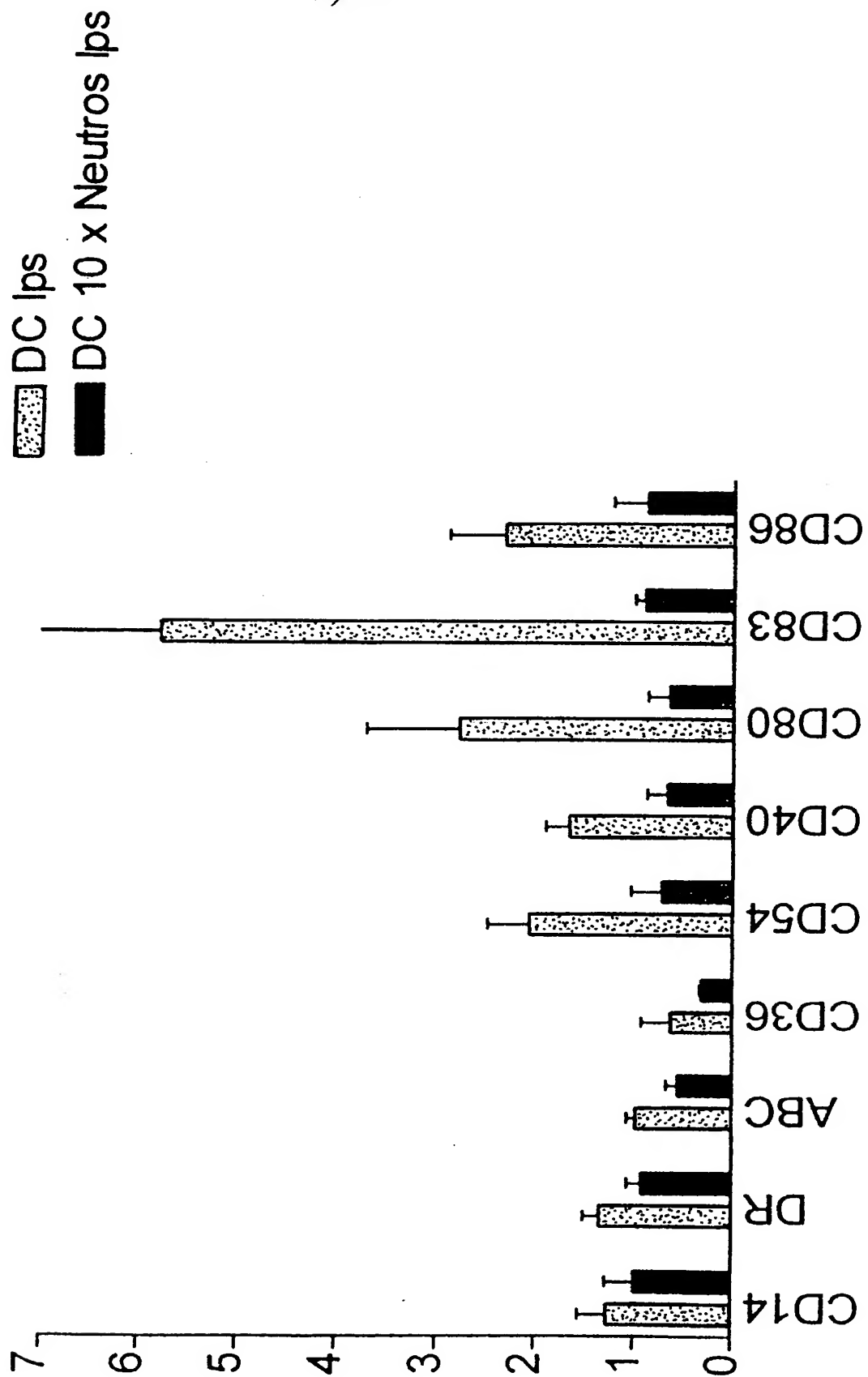


F/G. 9.



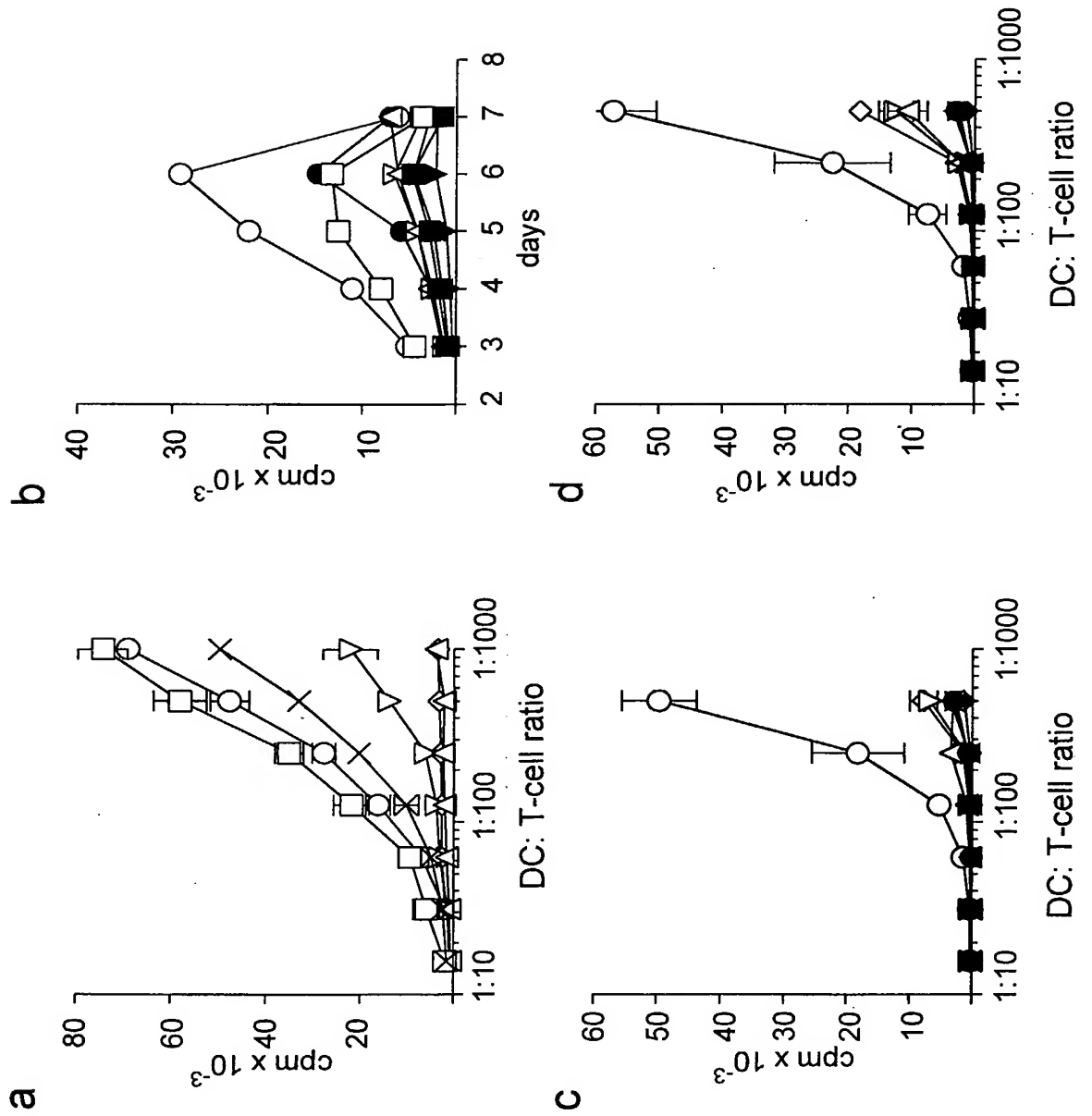
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FIG. 10.



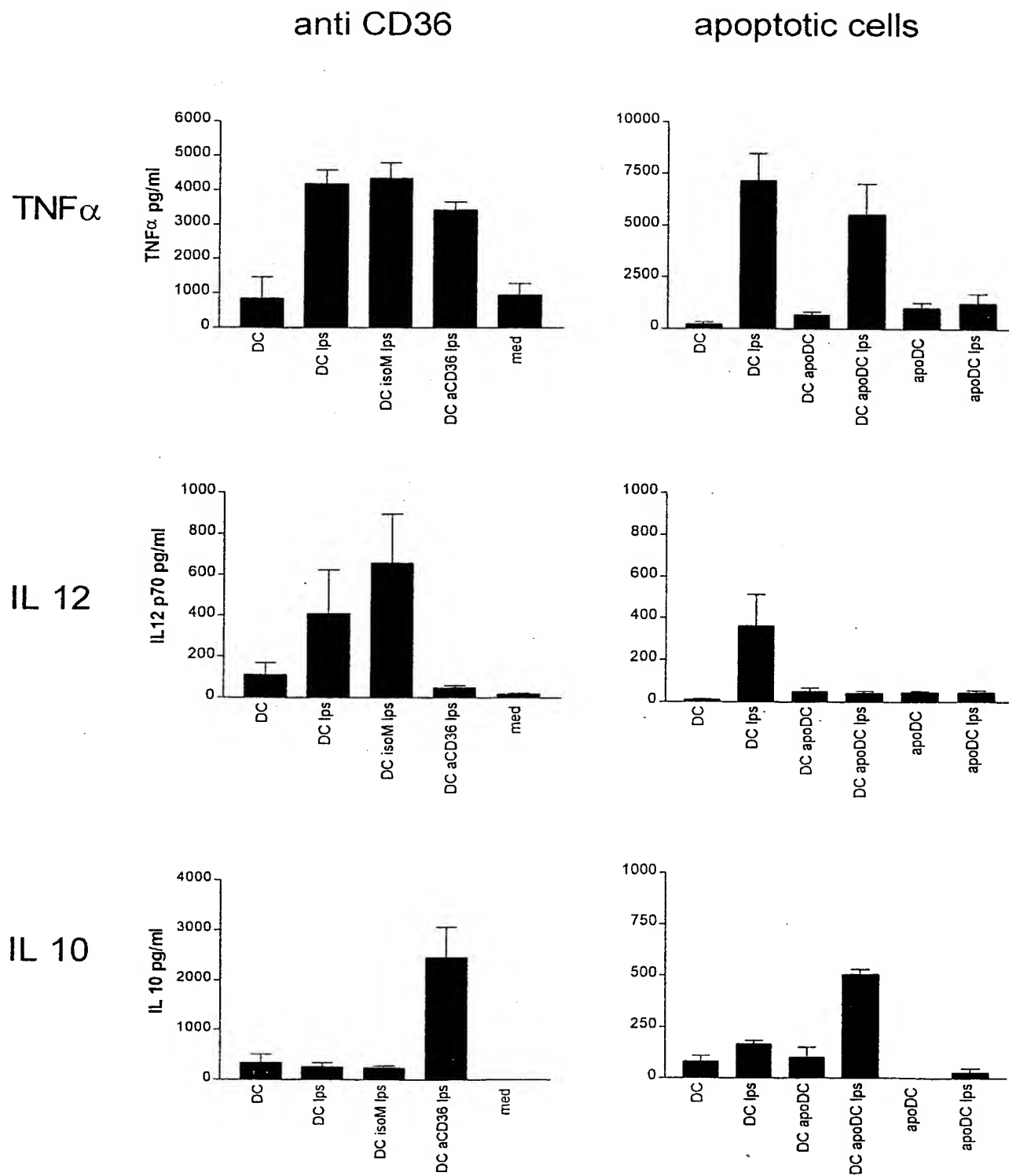
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FIG. 11.



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FIG. 12.



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FIG. 13.

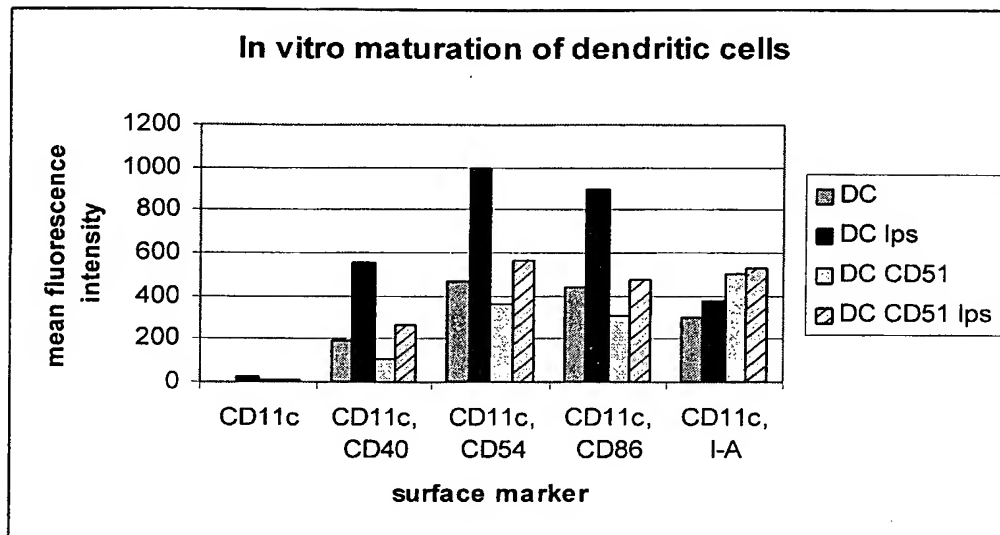


FIG. 14.

